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## ACCESSION NUMBER RANGES

Accession numbers cited in this Supplement fall within the following ranges.

STAR (N-10000 Series)	N85-10001 – N85-15656
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IAA (A-10000 Series)	A85-10001 – N85-19101
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# EARTH RESOURCES

## A CONTINUING BIBLIOGRAPHY WITH INDEXES

### Issue 45

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced between January 1 and March 31, 1985 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA).*

1985

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# INTRODUCTION

The technical literature described in this continuing bibliography may be helpful to researchers in numerous disciplines such as agriculture and forestry, geography and cartography, geology and mining, oceanography and fishing, environmental control, and many others. Until recently it was impossible for anyone to examine more than a minute fraction of the Earth's surface continuously. Now vast areas can be observed synoptically, and changes noted in both the Earth's lands and waters, by sensing instrumentation on orbiting spacecraft or on aircraft.

This literature survey lists 494 reports, articles, and other documents announced between January 1 and March 31, 1985 in *Scientific and Technical Aerospace Reports (STAR)*, and *International Aerospace Abstracts (IAA)*.

The coverage includes documents related to the identification and evaluation by means of sensors in spacecraft and aircraft of vegetation, minerals, and other natural resources, and the techniques and potentialities of surveying and keeping up-to-date inventories of such riches. It encompasses studies of such natural phenomena as earthquakes, volcanoes, ocean currents, and magnetic fields; and such cultural phenomena as cities, transportation networks, and irrigation systems. Descriptions of the components and use of remote sensing and geophysical instrumentation, their subsystems, observational procedures, signature and analyses and interpretive techniques for gathering data are also included. All reports generated under NASA's Earth Resources Survey Program for the time period covered in this bibliography will also be included. The bibliography does not contain citations to documents dealing mainly with satellites or satellite equipment used in navigation or communication systems, nor with instrumentation not used aboard aerospace vehicles.

The selected items are grouped in nine categories. These are listed in the Table of Contents with notes regarding the scope of each category. These categories were especially chosen for this publication, and differ from those found in *STAR* and *IAA*.

Each entry consists of a standard bibliographic citation accompanied by an abstract. The citations include the original accession numbers from the respective announcement journals.

Under each of the nine categories, the entries are presented in one of two groups that appear in the following order:

- IAA* entries identified by accession number series A85-10,000 in ascending accession number order;

- STAR* entries identified by accession number series N85-10,000 in ascending accession number order.

After the abstract section, there are six indexes:

- subject, personal author, corporate source, contract number, report/accession number, and accession number.

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All publications abstracted in this Section are available from the Technical Information Service, American Institute of Aeronautics and Astronautics, Inc. (AIAA), as follows: Paper copies of accessions are available at \$8.50 per document. Microfiche<sup>(1)</sup> of documents announced in *IAA* are available at the rate of \$4.00 per microfiche on demand. Standing order microfiche are available at the rate of \$1.45 per microfiche for *IAA* source documents.

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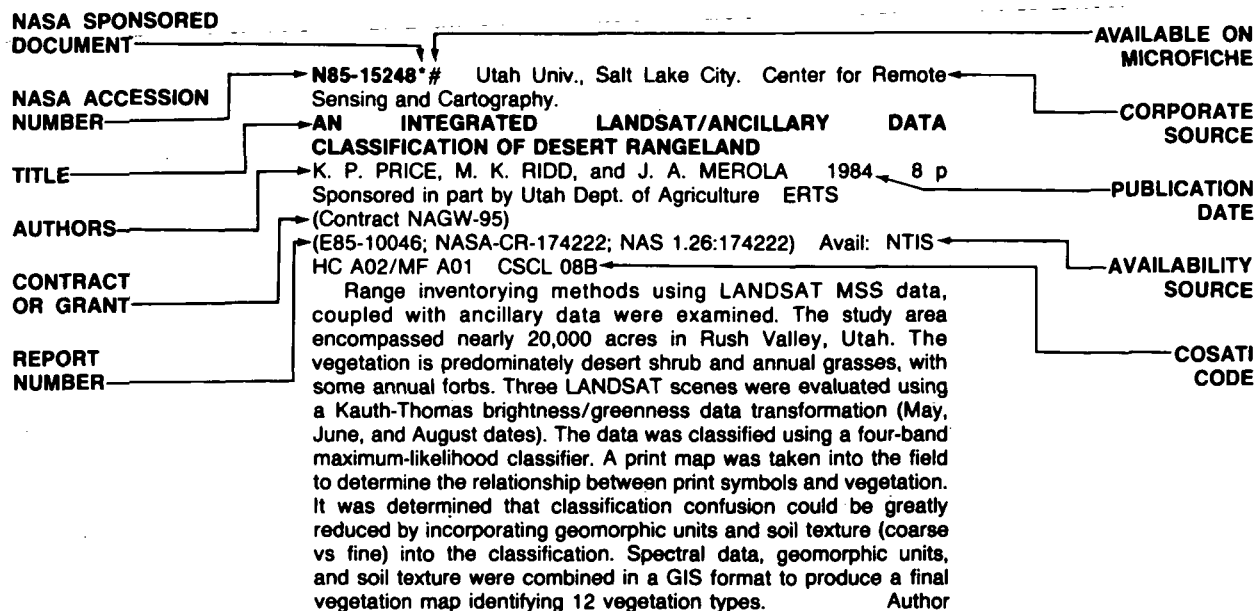
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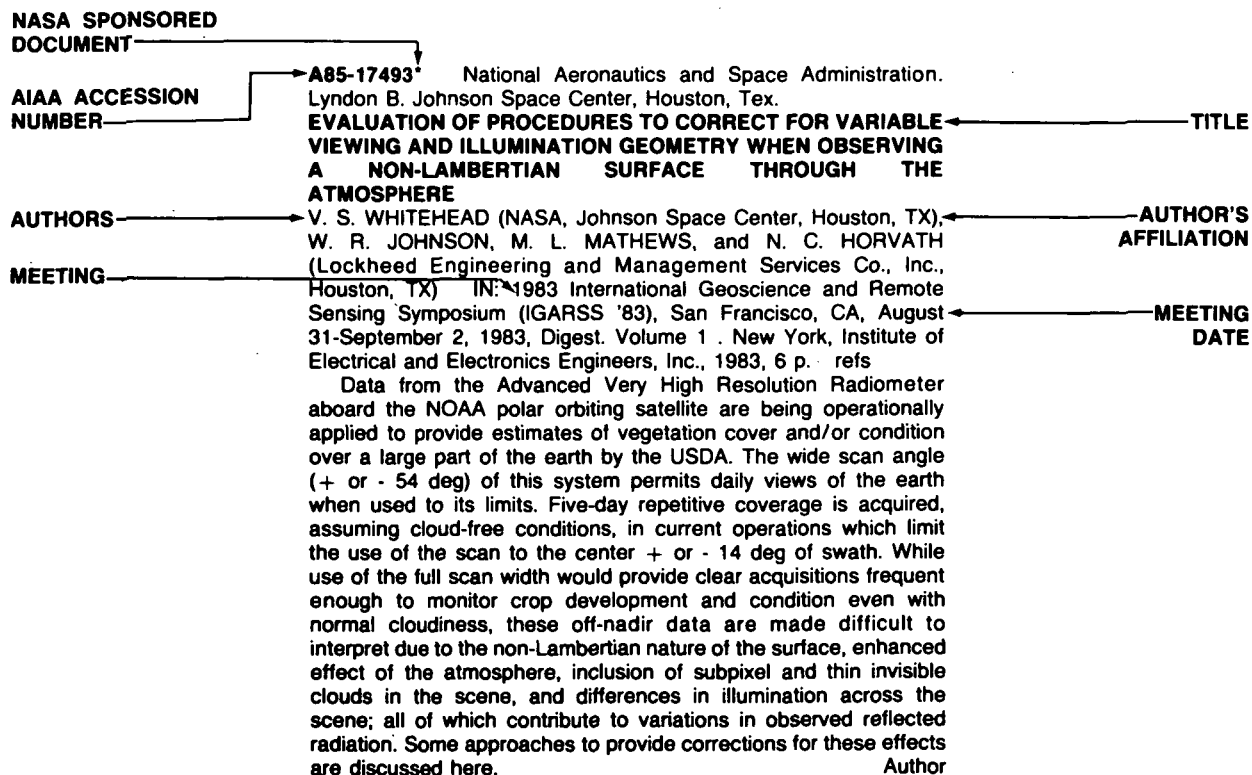
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## TYPICAL CITATION AND ABSTRACT FROM STAR



## TYPICAL CITATION AND ABSTRACT FROM IAA





# EARTH RESOURCES

*A Continuing Bibliography (Issue 45)*

APRIL 1985

01

## AGRICULTURE AND FORESTRY

Includes crop forecasts, crop signature analysis, soil identification, disease detection, harvest estimates, range resources, timber inventory, forest fire detection, and wildlife migration patterns.

**A85-10177\*#** National Aeronautics and Space Administration, Washington, D. C.

### NASA'S ACTIVITIES IN REMOTE SENSING

B. I. EDELSON (NASA, Washington, DC) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 7-19.

NASA spaceborne terrestrial remote-sensing projects of the 1960-1983 period are briefly surveyed, and future plans are outlined. The increased coverage of spectral bands and improving resolution provided by such satellites as Tiros, Seasat, and the ERTS/Landsat series are indicated; the Shuttle imaging radar, SAR, and multispectral IR radiometer are characterized; and the planned Upper-Atmospheric Research Satellite and ocean-topography experiment (Topex) are considered. Drawings and photographs of the spacecraft and sample images are included. T.K.

**A85-10183#**

### MULTITEMPORAL CHANGE DETECTION TECHNIQUES FOR THE IDENTIFICATION AND MONITORING OF FOREST DISTURBANCES

A. B. PARK (Natural Resources Consulting Services, Arnold, MD), R. A. HOUGHTON (Marine Biological Laboratory, Woods Hole, MA), G. M. HICKS, and C. J. PETERSON (General Electric Co., Space Div., Valley Forge, PA) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 77-97. refs (Contract DE-AC02-80EV-10468)

The increase in CO<sub>2</sub> in the atmosphere observed during the past century is due in part to deforestation. The extent to which deforestation has been and remains a source of CO<sub>2</sub> in the atmosphere is important for the prediction or control of the accumulation of atmospheric CO<sub>2</sub>. The use of satellite imagery seems to offer the possibility of obtaining new and objective information on rates of deforestation globally. This report presents results of a study designed to examine the potential use of Landsat data for this purpose. Author

**A85-10198#**

### MONITORING OF SOIL SALINITY IN INDO GANGETIC PLAINS OF NORTH WESTERN INDIA USING MULTIDATE LANDSAT DATA

L. VENKATARATNAM (National Remote Sensing Agency, Hyderabad, India) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 369-377.

**A85-10200#**

### IRRIGATED AGRICULTURE IN CUMBUM VALLEY IN SOUTH INDIA - A LANDSAT STUDY

S. THIRUVENGADACHARI (National Remote Sensing Agency, Hyderabad, India) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 389-397. refs

**A85-10206\*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

### SURFACE VEGETATIVE BIOMASS MODELLING FROM COMBINED AVHRR AND LANDSAT SATELLITE DATA

T. L. LOGAN (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) and A. H. STRAHLER (Hunter College, New York, NY) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 457-468. refs

A methodology for the estimation of regional biomass on the basis of Landsat and Polar Orbiter Satellite Advanced Very High Resolution Radiometer (AVHRR) imagery has been developed by the present study, which concentrated on the Sierra Nevada-Cascade Mountains ecological province of California. The Landsat data are only used initially, to calibrate the AVHRR-based biomass data. The essential element of the present approach is a 'pixel proportions' model. An integer block of Landsat pixels corresponds to each AVHRR pixel. The Landsat pixels are converted into biomass pixels using species biomass expression equations available in the literature. O.C.

**A85-10223#**

### DETECTION OF FLOODED AREA IN HOKKAIDO BASED ON LANDSAT MSS DATA

S. UEHARA, T. SATO (Science and Technology Agency, National Research Center for Disaster Prevention, Sakura, Ibaraki, Japan), K. TSUCHIYA (Chiba University, Chiba, Japan), and Y. YAMAURA (National Space Development Agency of Japan, Earth Observation Center, Ohashi, Saitama, Japan) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 677-686.

A study was made on the delineation of flooded areas with emphasis on damaged rice fields based on three sets of Landsat MSS CCT data taken on Aug. 27, Oct. 2, 1981, and May 15, 1982 after a large-scale flood in Hokkaido, Japan. Damaged rice plants had lower radiant reflectance at all Landsat MSS spectral bands than undamaged ones, especially in Band 7 (0.8-1.1 micron) which was quite effective in differentiating them. Since the classified areas as rice field from MSS CCT data taken on Aug. 27 and Oct. 2 contained pasture and river course, the correction was made through the use of May 15 MSS CCT data which showed distinctive difference in radiance between rice field before transplantation and the other lands with vegetation cover. The detected severely damaged rice field coincided with the heavily flooded areas. Author

## 01 AGRICULTURE AND FORESTRY

### A85-10229#

#### **AGRISTARS DCLC APPLICATIONS PROJECT - 1982 CORN AND SOYBEANS AREA ESTIMATES FOR IOWA AND ILLINOIS**

S. B. WININGS, P. W. COOK, and G. A. HANUSCHAK (U.S. Department of Agriculture, Statistical Research Div., Washington, DC) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 2 . Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 741-751. refs

### A85-10230#

#### **LANDSAT DIGITAL DATA PROCESSING FOR ESTIMATION OF AGRICULTURAL LAND IN EGYPT**

M. A. A. HADY, A. G. A. SAMIE, A. S. AYOUB (Remote Sensing Center, Cairo, Egypt), I. A. EL KASSAS (Nuclear Materials Corp., Cairo, Egypt), and A. O. SAAD (National Research Centre, Cairo, Egypt) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 2 . Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 753-772. refs

### A85-10231\*#

#### **Lockheed Engineering and Management Services Co., Inc., Houston, Tex.**

#### **DEVELOPMENT OF A QUANTITATIVE BASIS FOR SELECTION OF SPECTRAL FEATURES IN A VEGETATION MONITORING SYSTEM**

D. E. PHINNEY, J. H. SMITH (Lockheed Engineering and Management Services Co., Inc., Houston, TX), and M. C. TRICHEL (NASA, Johnson Space Center, Houston, TX) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 2 . Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 773-782. refs  
(Contract NAS9-15800)

The development of an objective methodology for evaluation of alternative Landsat data preprocessing options, spectral transform features for monitoring vegetation, and feature summarization algorithms is presented. Based on estimates of spectral separability between a target class and its confusion classes, analysis of variance techniques are used to evaluate potential design options for large scale vegetation monitoring systems. Case studies are presented for early season and through the season spring small grains separation and for barley/other spring small grains separation. It is concluded that a basis for efficient, objective selection among alternative feature extraction approaches has been established for the large scale vegetation mapping/inventory problem. Although the approach has been demonstrated for the unitemporal class separability case, extensions to the multitemporal case are under development.

Author

### A85-10232#

#### **A COMPARATIVE STUDY OF CLASSIFICATION ALGORITHMS FOR FORESTED REGION IMAGERY**

C. WANG and X. LI (Chinese Academy of Sciences, Space Science and Technology Center, Beijing, People's Republic of China) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 2 . Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 783-794. refs

Attention is given to the results of a study concerning the use of three classification algorithms, together with the relaxation technique, following initial classification of forested region multispectral scanner imagery by both supervised and unsupervised methods. The value of the relaxation postprocessing method for classification precision enhancement is verified by the results obtained. It is noted, however, that high quality samples are required for precision enhancement.

O.C.

### A85-10240\*#

#### **Utah Univ., Salt Lake City.** **DETECTION OF ASPEN/CONIFER FOREST MIXES FROM MULTITEMPORAL LANDSAT DIGITAL DATA**

J. A. MEROLA, R. A. JAYNES (Utah, University, Salt Lake City, UT), and R. O. HARNISS (U.S. Department of Agriculture, Forestry Sciences Laboratory, Logan, UT) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 2 . Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 883-893. Research supported by the U.S. Department of Agriculture. Previously announced in STAR as N83-15749. refs  
(Contract NAGW-95)

Aspen, conifer and mixed aspen/conifer forests were mapped for a 15-quadrangle study area in the Utah-Idaho Bear River Range using Landsat multispectral scanner data. Digital classification and statistical analysis of Landsat data allowed the identification of six groups of signatures which reflect different types of aspen/conifer forest mixing. Photo interpretations of the print symbols suggest that such classes are indicative of mid to late seral aspen forests. Digital print map overlays and acreage calculations were prepared for the study area quadrangles. Further field verification is needed to acquire additional information about the nature of the forests. Single data Landsat analysis should be a cost effective means to index aspen forests which are at least in the mid seral phase of conifer invasion. Since aspen canopies tend to obscure understory conifers for early seral forests, a second data analysis, using data taken when aspens are leafless, could provide information about early seral aspen forests.

Author

### A85-10242\*#

#### **Technicolor Government Services, Inc., Moffett Field, Calif.**

#### **BENCHMARK DATA ON THE SEPARABILITY AMONG CROPS IN THE SOUTHERN SAN JOAQUIN VALLEY OF CALIFORNIA**

A. MORSE (Technicolor Government Services, Inc., Moffett Field, CA) and D. H. CARD (NASA, Ames Research Center, Moffett Field, CA) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 2 . Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 907-914. refs  
(Contract NAS2-11101)

Landsat MSS data were input to a discriminant analysis of 21 crops on each of eight dates in 1979 using a total of 4,142 fields in southern Fresno County, California. The 21 crops, which together account for over 70 percent of the agricultural acreage in the southern San Joaquin Valley, were analyzed to quantify the spectral separability, defined as omission error, between all pairs of crops. On each date the fields were segregated into six groups based on the mean value of the MSS7/MSS5 ratio, which is correlated with green biomass. Discriminant analysis was run on each group on each date. The resulting contingency tables offer information that can be profitably used in conjunction with crop calendars to pick the best dates for a classification. The tables show expected percent correct classification and error rates for all the crops. The patterns in the contingency tables show that the percent correct classification for crops generally increases with the amount of greenness in the fields being classified. However, there are exceptions to this general rule, notably grain.

Author

### A85-10243#

#### **THE AGRICULTURAL INFORMATION SYSTEM SIMULATOR - AN OVERVIEW AND AN APPLICATION**

D. B. RAMEY and J. H. SMITH (Lockheed Engineering and Management Services Co., Inc., Houston, TX) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 2 . Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 915-922.

An important use of remotely sensed data is in the estimation of agricultural production in foreign areas. Evaluation of such production estimates is difficult because of the lack of independent crop inventories in foreign areas. This paper describes simulation software which will aid in the evaluation of the effect of various factors on the performance of Landsat-based agricultural

estimators. An application is presented which compares the Landsat-4 orbit with the orbits of earlier Landsats. Author

**A85-10245\*#** Technicolor Government Services, Inc., Moffett Field, Calif.

**TWO TECHNIQUES FOR MAPPING AND AREA ESTIMATION OF SMALL GRAINS IN CALIFORNIA USING LANDSAT DIGITAL DATA**

E. J. SHEFFNER (Technicolor Government Services, Inc., Moffett Field, CA), C. A. HLAVKA, and E. M. BAUER (NASA, Ames Research Center, Moffett Field, CA) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 937-944. refs

Two techniques have been developed for the mapping and area estimation of small grains in California from Landsat digital data. The two techniques are Band Ratio Thresholding, a semi-automated version of a manual procedure, and LCLS, a layered classification technique which can be fully automated and is based on established clustering and classification technology. Preliminary evaluation results indicate that the two techniques have potential for providing map products which can be incorporated into existing inventory procedures and automated alternatives to traditional inventory techniques and those which currently employ Landsat imagery. V.L.

**A85-10247\*#** Lockheed Electronics Co., Houston, Tex.  
**EARLY SEASON SPRING SMALL GRAINS PROPORTION ESTIMATION**

D. E. PHINNEY (Lockheed Electronics Co., Houston, TX) and M. C. TRICHEL (NASA, Johnson Space Center, Houston, TX) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 981-990. refs  
(Contract NAS9-15800)

An accurate, automated method for estimating early season spring small grains from Landsat MSS data is discussed. The method is summarized and the results of its application to 100 sample segment-years of data from the US Northern Great Plains in 1976, 1977, 1978, and 1979 are summarized. The results show that this estimator provides accurate estimates earlier in the growing season than previous methods. Ground truth is required only in the estimator development, and data storage, transmission, preprocessing, and processing requirements are minimal. C.D.

**A85-10250\*#** Environmental Research Inst. of Michigan, Ann Arbor.

**ASSESSMENT OF TECHNOLOGIES FOR CLASSIFICATION OF MIXED PIXELS**

M. D. METZLER and R. C. CICONE (Michigan, Environmental Research Institute, Ann Arbor, MI) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 1015-1021. refs  
(Contract NAS9-16538)

A new method of directly classifying mixed pixels is described. This method and four frequently used indirect mixed pixel classification techniques are evaluated on Landsat MSS data from the U.S. Corn Belt using an automatic corn and soybean labeling technique. The results indicate that while more sophisticated, physically-based techniques for classifying mixed pixels may yield a higher Percent Correct Classification (PCC) for those pixels, the net effect on a crop area proportion estimation procedure may be negative. Author

**A85-10256\*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**EFFECTS OF ATMOSPHERE AND VIEW AND ILLUMINATION GEOMETRY ON VISIBLE AND NEAR INFRARED RADIANCE DATA FROM THE ADVANCED VERY HIGH RESOLUTION RADIOMETER (AVHRR)**

B. N. HOLBEN and R. S. FRASER (NASA, Goddard Space Flight Center, Greenbelt, MD) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 1091-1100. refs

The use of Dave's models to evaluate satellite off-nadir remote sensing of green vegetation cover types by simulating the visible and near-infrared advanced very high resolution radiometer (AVHRR) NOAA-6 and NOAA-7 radiances for three green-leaf biomass levels and bare soil. Ground measurements of surface reflectances were used. The simulations were done along a scan line at 30 deg latitude during the summer solstice, equinox, and winter solstice. The simulation models are described and the effect of atmosphere over moderately vegetated surfaces is discussed. The results show that sensor response to atmospheric path length can be substantial for the AVHRR visible and near-infrared channels and normalized difference values, but they can be minimized by high sun and clear atmospheric viewing. The results indicate that AVHRR data would be most useful for monitoring low green leaf biomass canopies. C.D.

**A85-10278\*#** Environmental Research Inst. of Michigan, Ann Arbor.

**INVESTIGATIONS OF THEMATIC MAPPER DATA DIMENSIONALITY AND FEATURES USING FIELD SPECTROMETER DATA**

E. P. CRIST and R. C. CICONE (Michigan, Environmental Research Institute, Ann Arbor, MI) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 1313-1322. refs  
(Contract NAS9-16538)

Landsat-4 TM and MSS data, simulated from field reflectance spectra, are used to determine the dimensionality and structure of TM data (excluding the thermal band), demonstrate the relationships between the two sensors, and derive a Tasseled Cap Transformation for TM data. The simulated TM data are found to primarily occupy three dimensions, and to be concentrated into two adjoining and orthogonal planes and a transition zone between the two. The 'Plane of Vegetation' is shown to be comparable to the MSS Tasseled Cap plane, while the 'Plane of Soils' represents new information. The potential for improved spectral estimation of the relative mix of vegetation and soil in the field of view, and for improved monitoring of soil moisture status, is demonstrated. Author

**A85-10279\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**THEMATIC MAPPER SIMULATOR RESEARCH FOR FOREST RESOURCE MAPPING IN THE CLEARWATER NATIONAL FOREST, IDAHO**

J. A. BRASS, D. L. PETERSON (NASA, Ames Research Center, Moffett Field, CA), M. A. SPANNER, V. G. AMBROSIA (Technicolor Government Services, Inc., Moffett Field, CA), J. J. ULLIMAN, and J. BROCKHAUS (Idaho, University, Moscow, ID) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 1323-1332. refs

Per-pixel maximum likelihood digital classification and photo interpretation of Thematic Mapper Simulator (TMS) composited images for a managed conifer forest were used to evaluate both land cover and forest structure characteristics. TMS channels 4, 7, 5 and 3, which were found to be optimal for forest vegetation analysis, used the full range of the Thematic Mapper's spectral capability. Photo interpretation results indicate that a false color composite from TMS channels 4, 7, and 2 provided the highest

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accuracies; the combination of improved spatial, spectral and radiometric resolution of the Thematic Mapper yielded greater sensitivity to forest structural characteristics. O.C.

**A85-10281\*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

### **REMOTE SENSING ADVANCES IN AGRICULTURAL INVENTORIES**

J. L. DRAGG, R. M. BIZZELL, M. C. TRICHEL (NASA, Johnson Space Center, Houston, TX), R. E. HATCH (U.S. Department of Agriculture, Houston, TX), D. E. PHINNEY (Lockheed Engineering and Management Services Co., Inc., Houston, TX), and T. C. BAKER IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 1343-1352. refs

As the complexity of the world's agricultural industry increases, more timely and more accurate world-wide agricultural information is required to support production and marketing decisions, policy formulation, and technology development. The Inventory Technology Development Project of the AgRISTARS Program has developed new automated technology that uses data sets acquired by spaceborne remote sensors. Research has emphasized the development of multistage, multisensor sampling and estimation techniques for use in global environments where reliable ground observations are not available. This paper presents research results obtained from data sets acquired by four different sensors: Landsat MSS, Landsat TM, Shuttle-Imaging Radar and environmental satellite (AVHRR). Author

**A85-10289\*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

### **LANDSAT THEMATIC MAPPER (TM) SOIL VARIABILITY ANALYSIS OVER WEBSTER COUNTY, IOWA**

D. R. THOMPSON, K. E. HENDERSON, and D. E. PITTS (NASA, Johnson Space Center, Houston, TX) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 1429-1435. refs

Thematic mapper simulator (TMS) data acquired June 7, June 23, and July 31, 1982, and Landsat thematic mapper (TM) data acquired August 2, September 3, and October 21, 1982, over Webster County, Iowa, were examined for within-field soil effects on corn and soybean spectral signatures. It was found that patterns displayed on various computer-generated map products were in close agreement with the detailed soil survey of the area. The difference in spectral values appears to be due to a combination of subtle soil properties and crop growth patterns resulting from the different soil properties. Bands 4 (0.76-.90 micron), 5 (1.55-1.75 micron), and 7 (2.08-2.35 micron) were found to be responding to the within-field soil variability even with increasing ground cover. While these results are preliminary, they do indicate that the soil influence on the vegetation is being detected by TM and should provide improved information relating to crop and soil properties. Author

**A85-10604**

### **MULTITEMPORAL SEGMENTATION AND ANALYSIS IN REMOTE SENSING**

R. JEANSOULIN, E. CALS, and J. C. DARCOS (CNRS, Laboratoire Langages et Systemes Informatiques, Toulouse, France) IN: Applications of digital image processing; Proceedings of the Meeting, Geneva, Switzerland, April 19-22, 1983. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1983, p. 13-20. refs

Processes of multitemporal segmentation, extraction, and analysis of remote sensing images are examined with reference to the Lauragais project, a remote sensing experiment designed to evaluate SPOT data performance for agricultural management and yield assessment. A nonexhaustive multispectral segmentation based on a fuzzy-set approach is developed for the individualization of entities (parcels of land) on each monitemporal image. A geometric database for accessing image data on an entity-by-entity

basis is developed for the geometric description of the spatial relations between segmented entities. Finally, a criterion for comparing geometric descriptions from date to date is given, and a multitemporal landscape description is considered which involves the mixing of the segmentation results in a training set in order to compile a new classification scheme. B.J.

**A85-11201\*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

### **A SUMMARY OF THE HISTORY OF THE DEVELOPMENT OF AUTOMATED REMOTE SENSING FOR AGRICULTURAL APPLICATIONS**

R. B. MACDONALD (NASA, Johnson Space Center, Houston, TX) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-22, Nov. 1984, p. 473-482. refs

An historical account is given of the development of technology for the processing of satellite-acquired multispectral data aimed at the identification of the type, condition, and ontogenic stages of agricultural areas. During 1972 and 1973, research established the feasibility of automating digital classification for the processing of large volumes of Landsat MSS data. This capability was successfully demonstrated during the Large Area Crop Inventory Experiment, which estimated wheat crop production on a global basis. This achievement in turn led to the Agriculture and Resources Inventory Surveys Through Aerospace Remote Sensing, which investigated other portions of the electromagnetic spectrum and expanded the study of key commercial crops in important agricultural areas. O.C.

**A85-11202\*** Technicolor Government Services, Inc., Moffett Field, Calif.

### **FEATURE SELECTION AND THE INFORMATION CONTENT OF THEMATIC MAPPER SIMULATOR DATA FOR FOREST STRUCTURAL ASSESSMENT**

M. A. SPANNER (Technicolor Government Services, Inc., Moffett Field, CA), J. A. BRASS, and D. L. PETERSON (NASA, Ames Research Center, Moffett Field, CA) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-22, Nov. 1984, p. 482-489. refs

An assessment is made of the information content of Thematic Mapper Simulator (TMS) data for the case of a forested region, in order to determine the sensitivity of such data to forest crown closure and tree size class. Principal components analysis and Monte Carlo simulation indicated that channels 4, 7, 5 and 3 were optimal for four-channel forest structure analysis. As the number of channels supplied to the Monte Carlo feature selection routine increased, classification accuracy increased. The greatest sensitivity to the forest structural parameters, which included succession within clearcuts as well as crown closure and size class, was obtained from the 7-channel TMS data. O.C.

**A85-11203\*** Technology Service Corp., Silver Spring, Md.

### **UTILIZATION OF VEGETATION INDICES TO IMPROVE MICROWAVE SOIL MOISTURE ESTIMATES OVER AGRICULTURAL LANDS**

S. W. THEIS (Technology Service Corp., Silver Spring, MD), B. J. BLANCHARD (NASA, Goddard Space Flight Center, Hydrologic Sciences Branch, Greenbelt, MD), and R. W. NEWTON (Texas A&M University, College Station, TX) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-22, Nov. 1984, p. 490-496. Research supported by the U.S. Geological Survey and U.S. Department of Agriculture. refs  
(Contract NSG-5134; NOAA-MO-A01-78-00-4332)

A technique is presented by means of which visible/near-IR data are used to develop corrections in remotely sensed microwave soil moisture signals, in order to account for vegetation effects. Visible/IR data collected with the NASA NS001 Thematic Mapper Simulator were used to calculate the Perpendicular Vegetation Index (PVI), which was then related to the change of sensitivity of the microwave measurement to surface soil moisture. Effective estimation of soil moisture in the presence of vegetation can be made with L-band microwave radiometers and visible/IR sensors when the PVI is lower than 4.3. This technique offers a means

for the estimation of moisture from a space platform over many agricultural areas, without expensive ground data collection.

O.C.

**A85-11204\*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**CONSIDERATIONS OF AND IMPROVEMENTS TO LARGE-SCALE VEGETATION MONITORING**

J. A. GATLIN, R. J. SULLIVAN, and C. J. TUCKER (NASA, Goddard Space Flight Center, Greenbelt, MD) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-22, Nov. 1984, p. 496-502. refs

The NOAA-7 polar orbiting sun-synchronous operational satellite carries the 5-channel advanced very high-resolution radiometer which acquires data globally at a spatial resolution of 4 km on a daily basis. These data provide a means for frequently monitoring global vegetation at continental scales. Techniques for compositing and cloud screening a green leaf density vegetation index product for Africa are presented for 9 sequential days beginning August 16, 1982 and are compared with a semi-operational vegetation index product produced by NOAA.

Author

**A85-11206\*** National Aeronautics and Space Administration. National Space Technology Labs., Bay Saint Louis, Miss.

**ASSESSMENT OF LANDSAT MULTISPECTRAL SCANNER SPECTRAL INDEXES FOR MONITORING ARID RANGELAND**

H. B. MUSICK (NASA, National Space Technology Laboratories, Earth Resources Laboratory, Bay St. Louis, MS) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-22, Nov. 1984, p. 512-519. refs

Correlations between spectral indices and vegetation parameters in south-central New Mexico were used to determine the utility of Landsat Multispectral Scanner (MSS) spectral indices in arid rangeland monitoring. In addition, spectral index change for 1976-1980 was calculated from retrospective MSS data and compared with qualitative ground truth in order to evaluate vegetation change detection by means of spectral indices. Brightness index change consistently differentiated between cover increase and decrease, but index change appears to have been offset from true cover change; this may at least partly be attributed to the failure of the methods used to standardize MSS scenes for differences in sensor response. Green vegetation indices, by contrast to brightness indices, failed to consistently differentiate between cover increase and decrease.

O.C.

**A85-11209\*** Kansas Univ. Center for Research, Inc., Lawrence. **A REEXAMINATION OF SOIL TEXTURAL EFFECTS ON MICROWAVE EMISSION AND BACKSCATTERING**

M. C. DOBSON, F. KOUYATE (University of Kansas Center for Research, Inc., Lawrence, KS), and F. T. ULABY (Michigan, University, Ann Arbor, MI) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-22, Nov. 1984, p. 530-536. refs

(Contract NAG5-30)

Microwave frequency measurements of moist soil dielectric properties are noted to challenge the validity of percent-of-field-capacity as a moisture indicator that is independent of soil texture in terms of microwave sensitivity. In arriving at this view, gravimetric, volumetric, and percent-of-field-capacity were tested for their ability to reduce dielectric behavior divergence between soil textures at 1.4 and 5.0 GHz. The most congruent dielectric behavior between soil textures is found to occur when soil moisture is expressed on a volumetric basis that is proportional to the number of water dipoles/unit volume. An inadequate characterization of soil bulk density in the field, combined with the dependency of bulk density on water retention at field capacity, offers the most plausible explanation for the earlier conclusions.

O.C.

**A85-11211**

**SEPARABILITY OF AGRICULTURAL CROPS WITH AIRBORNE MULTIPARAMETER RADARS**

N. C. MEHTA (Lockheed Engineering and Management Services Co., Inc., Houston, TX) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-22, Nov. 1984, p. 540-546.

Backscattering measurements were acquired with airborne radar scatterometers over a test site in Cass County, North Dakota on four days in the summer of 1981. Data were acquired at three frequencies (L-, C- and Ku-bands), two polarizations (like and cross) and ten incidence angles (5 to 50 deg). Crop separability was examined using a two-class separability measure, which compares within-class to between-class variability. Based on this separability measure, a scatterometer channel most suited for separating each pair of crops was selected and the separability errors were calculated by choosing a subjective decision boundary to separate the two crops. Within the small grains class, higher frequencies were found to be useful, with good to very good separability in most cases. Both L- and Ku-bands were helpful for separability within the nonsmall grains class, with mostly very good to excellent results. By discarding mixed pixels, substantial improvement was obtained in both the two-class separability and the separability errors for various crops. These results are helpful in selecting system parameters of future active microwave remote sensors in vegetation discrimination and characterization studies.

Author

**A85-11230\*** National Aeronautics and Space Administration. National Space Technology Labs., Bay Saint Louis, Miss.

**A POTENTIAL GLOBAL SOILS DATA BASE**

E. R. STONER (NASA, National Space Technology Laboratories, Earth Resources Laboratory, Bay St. Louis, MS; Cornell University, Planaltina, Brazil), A. T. JOYCE (NASA, National Space Technology Laboratories, Earth Resources Laboratory, Bay St. Louis, MS), and H. C. HOGG (NASA, Washington, DC) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-22, Nov. 1984, p. 725-727. refs

A general procedure is outlined for refining the existing world soil maps from the existing 1:1 million scale to 1:250,000 through the interpretation of Landsat MSS and TM images, and the use of a Geographic Information System to relate the soils maps to available information on climate, topography, geology, and vegetation.

Author

**A85-11815**

**APPLICATION OF SPACE PHOTOGRAPHIC DATA FOR THE MAPPING OF VEGETATION COVER [PRIMENENIE KOSMICHESKOI FOTOINFORMATSII DLIA KARTOGRAFIROVANIJA RASTITEL'NOGO POKROVA]**

T. V. VERESHCHAKA, B. V. KRASNOPEVTSEVA, and V. V. USOVA (Moskovskii Institut Inzhenerov Geodezii, Aerofotos'emki i Kartografi, Moscow, USSR) Geodeziia i Aerofotos'emka (ISSN 0536-101X), no. 4, 1984, p. 99-106. In Russian.

The paper examines the compilation of vegetation maps on the basis of Salyut-5 remote-sensing data. Also considered are methodological questions pertaining to the interpretation of images of vegetation cover in the compilation of topographic survey maps. Tables are presented, describing vegetation-cover location and dynamics in various altitude zones (150 m to more than 2200 m) and the relationship with relief.

B.J.

**A85-12054\*** Department of Agriculture, Sydney, Mont.

**SPRING WHEAT-LEAF PHYTOMASS AND YIELD ESTIMATES FROM AIRBORNE SCANNER AND HAND-HELD RADIOMETER MEASUREMENTS**

J. K. AASE, F. H. SIDDOWAY (U.S. Department of Agriculture, Agricultural Research Service, Sidney, MT), and J. P. MILLARD (NASA, Ames Research Center, Moffett Field, CA) International Journal of Remote Sensing (ISSN 0143-1161), vol. 5, Sept.-Oct. 1984, p. 771-781. refs

An attempt has been made to relate hand-held radiometer measurements, and airborne multispectral scanner readings, with both different wheat stand densities and grain yield. Aircraft

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overflights were conducted during the tillering, stem extension and heading period stages of growth, while hand-held radiometer readings were taken throughout the growing season. The near-IR/red ratio was used in the analysis, which indicated that both the aircraft and the ground measurements made possible a differentiation and evaluation of wheat stand densities at an early enough growth stage to serve as the basis of management decisions. The aircraft data also corroborated the hand-held radiometer measurements with respect to yield prediction. Winterkill was readily evaluated. O.C.

**A85-12055\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.  
**USE OF LANDSAT-DERIVED PROFILE FEATURES FOR SPRING SMALL-GRAINS CLASSIFICATION**

G. D. BADHWAR (NASA, Johnson Space Center, Houston, TX) International Journal of Remote Sensing (ISSN 0143-1161), vol. 5, Sept.-Oct. 1984, p. 783-797. refs

The present model for the temporal behavior of agricultural greenness is applied to the extraction of Landsat-derived profile features, distinguishing small from large grain crops. An additional feature derivable from the temporal behavior of the ratio of greenness to brightness is noted which aids in the separation of crops from other vegetation. A limited training set of 20 pure pixels/class, obtained from ground data, is subjected to the Ho-Kashyap (1965) linear classifier. The initial correct classification value for pure pixels of about 85 percent drops to 75 percent for all Landsat pixels. O.C.

**A85-12297**  
**THE IDENTIFICATION OF IRRIGATED CROP TYPES AND ESTIMATION OF ACREAGES FROM LANDSAT IMAGERY**

K. E. KOLM (Colorado School of Mines, Golden; U.S. Geological Survey, Denver, CO) and H. L. CASE, III (U.S. Geological Survey, Albuquerque, NM) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 50, Oct. 1984, p. 1479-1490. Research supported by the U.S. Geological Survey. refs

The following techniques for identifying irrigated-crop types and estimating crop acreage in the High Plains of South Dakota using Landsat imagery are evaluated: (1) visual interpretation of false-color IR composite images; (2) density analysis and classifications of single-band images; (3) ratio-cutoff and classifications of logarithmically stretched images (LSIs) based on the band 7/band 5 ratio; and (4) combined supervised and unsupervised classifications (SUSs) of multiple-band images. Visual interpretations of level-sliced classifications of the LSIs and visual interpretations of smoothed SUSs of multiple-band images produced the best identifications of crop type and estimates of acreages: The LSI technique was the most economical; and the SUS technique was the most accurate. B.J.

**A85-12538#**  
**APPLICATION OF SPACE REMOTE-SENSING TO THE PREDICTION OF RICE PRODUCTION IN THE NIGER BASIN [APPLICAZIONE DEL TELERILEVAMENTO SPAZIALE ALLA PREVISIONE DELLE PRODUZIONI RISICOLE NEL BACINO DEL NIGER]**

A. BERG (Commission of the European Communities, Joint Research Centre, Ispra, Italy) IN: International Conference on Space, 24th, Rome, Italy, March 22, 23, 1984, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1984, p. 35-45. In Italian. refs

**A85-12866\*** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**DYNAMIC DESCRIPTORS FOR CONTEXTUAL CLASSIFICATION OF REMOTELY SENSED HYPERSPECTRAL IMAGE DATA ANALYSIS**

W. C. CHIOU, SR. (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) Applied Optics (ISSN 0003-6935), vol. 23, Nov. 1, 1984, p. 3889-3892. NASA-supported research.

The extended CIE transformation procedure of Chiou (1984) is applied to five sets of remotely sensed 0.4-2.5-micron spectrometric

data on field crops including winter and spring wheat, corn, and soybeans) obtained at the Purdue University Laboratory for Applications of - Remote Sensing during 1977-1980 using the techniques described by Hinzman (1981). The results are presented in tables and chromaticity diagrams and it is found that each crop has an identifiable time-variant spectral characteristic permitting determination of seasonal growth patterns. The applicability of the method to data from airborne and spaceborne imaging spectrometers is indicated. T.K.

**A85-12971\*** Delaware Univ., Newark.

**REMOTE SENSING OF BIOMASS AND ANNUAL NET AERIAL PRIMARY PRODUCTIVITY OF A SALT MARSH**

M. A. HARDISKY, V. KLEMAS (Delaware University, Newark, DE), F. C. DAIBER (Scranton University, Scranton, PA; Delaware University, Newark, DE), and C. T. ROMAN (Rutgers University, New Brunswick, NJ; Delaware University, Newark, DE) Remote Sensing of Environment (ISSN 0034-4257), vol. 16, Oct. 1984, p. 91-106. Research supported by the University of Delaware. refs (Contract NAS5-27580)

Net aerial primary productivity is the rate of storage of organic matter in above-ground plant issues exceeding the respiratory use by the plants during the period of measurement. It is pointed out that this plant tissue represents the fixed carbon available for transfer to and consumption by the heterotrophic organisms in a salt marsh or the estuary. One method of estimating annual net aerial primary productivity (NAPP) required multiple harvesting of the marsh vegetation. A rapid nondestructive remote sensing technique for estimating biomass and NAPP would, therefore, be a significant asset. The present investigation was designed to employ simple regression models, equating spectral radiance indices with *Spartina alterniflora* biomass to nondestructively estimate salt marsh biomass. The results of the study showed that the considered approach can be successfully used to estimate salt marsh biomass. G.R.

**A85-12975\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

**CLASSIFICATION OF CORN AND SOYBEANS USING MULTITEMPORAL THEMATIC MAPPER DATA**

G. D. BADHWAR (NASA, Johnson Space Center, Houston, TX) Remote Sensing of Environment (ISSN 0034-4257), vol. 16, Oct. 1984, p. 175-181. refs

The multitemporal classification approach based on the greenness profile derived from Landsat Multispectral Scanner (MSS) spectral bands has proved successful in effectively separating and identifying corn, soybean, and other ground cover classes. Features derived from these profiles have been shown to carry virtually all the information contained in the original data and, in addition, have been shown to be stable over a large geographic area of the United States. The objective of this investigation was to determine if the same features derived from multitemporal Thematic Mapper (TM) data would also prove effective in separating these two crop types, and, in fact, if algorithms developed for MSS could be directly applied to TM. It is shown that this is indeed the case. In addition, because of greater spatial and spectral resolution, the accuracy of TM classifications is better than in MSS. Author

**A85-13075#**

**DETECTION OF THE DAMAGE OF RICE FIELD DUE TO FLOODING BASED ON LANDSAT MSS DATA**

S. UEHARA, S. KISHI, T. SATO (Science and Technology Agency, National Research Center for Disaster Prevention, Sakura, Ibaraki, Japan), K. TACHI (National Space Development Agency of Japan, Earth Observation Center, Saitama, Japan), H. OCHIAI (Toba National Merchant Marine College, Toba, Mie, Japan), and K. TAKEDA (Remote Sensing Technology Center, Tokyo, Japan) International Astronautical Federation, International Astronautical Congress, 35th, Lausanne, Switzerland, Oct. 7-13, 1984. 10 p. (IAF PAPER 84-128)

A85-13076#

**RENEWABLE RESOURCE STUDIES USING THE NOAA POLAR-ORBITING SATELLITES**

S. R. SCHNEIDER (NOAA, National Environmental Satellite, Data, and Information Service, Washington, DC) International Astronautical Federation, International Astronautical Congress, 35th, Lausanne, Switzerland, Oct. 7-13, 1984. 16 p. refs (IAF PAPER 84-130)

Landsat satellites with Multi Spectral Scanners (MSS) have been used extensively in monitoring renewable resources. In addition to the information available from Landsat satellites, data about renewable resources are now also provided by the polar-orbiting satellites of the National Oceanic and Atmospheric Administration (NOAA) equipped with the Advanced Very High Resolution Radiometer (AVHRR). The AVHRR yields a resolution of 1.1 km at nadir. An advantage of a use of NOAA satellites for monitoring green vegetation is that they provide daily observations, while Landsat has a repeat time of 18 days. Thus large gaps can occur in the Landsat coverage, if the area of interest is cloudy. Attention is given to details regarding the NOAA satellites, NOAA vegetation index products, the Nile Delta Project, the Lake Chad Project, the Fire-Fuels Project, and Climate/Deforestation Projects. G.R.

A85-13077#

**SPACE OBSERVATIONS IN AGRICULTURAL INFORMATION SYSTEMS - A REVIEW OF TODAY'S SYSTEMS WITH REQUIREMENTS FOR TOMORROW**

E. S. MERRITT (Earth Satellite Corp., Chevy Chase, MD) International Astronautical Federation, International Astronautical Congress, 35th, Lausanne, Switzerland, Oct. 7-13, 1984. 18 p. (IAF PAPER 84-131)

A85-14322

**MAPPING THE VEGETATION RESOURCES OF ARID ZONES USING SPACE REMOTE-SENSING DATA [KARTOGRAFIROVANIE RASTITEL'NYKH RESURSOV ARIDNYKH ZON S ISPOL'ZOVANIEM KOSMICHESKOI FOTOFORMATSII]**

V. S. KHRUTSKII Geodesiia i Kartografiia (ISSN 0016-7126), Sept. 1984, p. 51-56. In Russian. refs

The use of satellite remote-sensing techniques for the vegetation mapping of arid areas is examined, and the possibilities of the direct and indirect interpretation of vegetation cover using local landscape indicators are evaluated. Particular consideration is given to relief interpretation, the interpretation of rocks and friable deposits, and the interpretation and classification of vegetation. Finally, the characteristics of field and laboratory work pertaining to the generation of pasture maps are examined. L.M.

A85-14633

**SPACE SCIENCE FOR AGRICULTURE [KOSMONAVTIKA - SEL'SKOMU KHOZIAISTVU]**

T. V. MASHKEVICH Moscow, Izdatel'stvo Kolos, 1984, 96 p. In Russian.

Applications of the advances in space science to agriculture are reviewed. In particular, it is shown how satellites, spacecraft, and orbital stations help improve production management in farming, forestry, and plant growing. The ways in which space science and technology can contribute to the implementation of the 'Food Program' in the Soviet Union are examined. V.L.

A85-16887

**USE OF MICROWAVES OVER LAND [MIKROWELLEN IM EINSATZ UEBER LAND]**

A. J. SIEBER (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Hochfrequenztechnik, Oberpfaffenhofen, West Germany) Zeitschrift fuer Flugwissenschaften und Weltraumforschung (ISSN 0342-068X), vol. 8, Sept.-Oct. 1984, p. 331-335. In German.

The benefits of imaging radar sensors for land applications are discussed in the light of available results. Technical aspects of the use of microwaves for remote sensing are reviewed, and

examples of the use of such sensing to study vegetation are addressed. The significance of various kinds of scattering behavior for the determination of plant characteristics is explained. C.D.

A85-16895#

**AGRICULTURE AND REMOTE SENSING APPLICATION IN NEPAL**

K. B. MALLA (National Remote Sensing Centre, Nepal) AARS, vol. 2, no. 2, 1984, p. 10-12.

The role of modern technology in the development of agricultural practices in Nepal is examined. Soil infertility resulting from severe soil erosion, erratic rainfall distribution, the lack of basic agricultural information and technology, and the lack of irrigation facilities have resulted in low crop yields. Water utilization programs and land levelling as well as other techniques involving the right doses and combination of seeds, fertilizers, and pesticides have been initiated by the government to increase agricultural production. The National Remote Sensing Center in Nepal which provides training in remote sensing application and a data bank for natural resource information are discussed. A study using Landsat imagery and aerial photography was conducted in order to demonstrate a remote sensing technique for estimating winter wheat acreage. M.D.

A85-16943

**PROBLEMS REGARDING THE STUDY AND EVALUATION OF THE EFFECTS OF FOREST FIRES ON THE BASIS OF A UTILIZATION OF AEROSPACE PHOTOGRAPHS [ZADACHI IZUCHENIIA I OTSENKI POSLEDSTVII LESNYKH POZHAROV S ISPOL'ZOVANIEM AEROKOSMICHESKIKH SNIMKOV]**

V. V. FURIAEV (Akademiia Nauk SSSR, Institut Lesa i Drevesiny, Krasnoyarsk, USSR) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), Sept.-Oct. 1984, p. 51-57. In Russian. refs

A85-17493\* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

**EVALUATION OF PROCEDURES TO CORRECT FOR VARIABLE VIEWING AND ILLUMINATION GEOMETRY WHEN OBSERVING A NON-LAMBERTIAN SURFACE THROUGH THE ATMOSPHERE**

V. S. WHITEHEAD (NASA, Johnson Space Center, Houston, TX), W. R. JOHNSON, M. L. MATHEWS, and N. C. HORVATH (Lockheed Engineering and Management Services Co., Inc., Houston, TX) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 6 p. refs

Data from the Advanced Very High Resolution Radiometer aboard the NOAA polar orbiting satellite are being operationally applied to provide estimates of vegetation cover and/or condition over a large part of the earth by the USDA. The wide scan angle (+ or - 54 deg) of this system permits daily views of the earth when used to its limits. Five-day repetitive coverage is acquired, assuming cloud-free conditions, in current operations which limit the use of the scan to the center + or - 14 deg of swath. While use of the full scan width would provide clear acquisitions frequent enough to monitor crop development and condition even with normal cloudiness, these off-nadir data are made difficult to interpret due to the non-Lambertian nature of the surface, enhanced effect of the atmosphere, inclusion of subpixel and thin invisible clouds in the scene, and differences in illumination across the scene; all of which contribute to variations in observed reflected radiation. Some approaches to provide corrections for these effects are discussed here. Author



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**A85-17522\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

### **SPECTRAL REFLECTANCE OF SURFACE SOILS - A STATISTICAL ANALYSIS**

K. R. CROUSE, D. L. HENNINGER, and D. R. THOMPSON (NASA, Johnson Space Center, Houston, TX) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 8 p. refs

The relationship of the physical and chemical properties of soils to their spectral reflectance as measured at six wavebands of Thematic Mapper (TM) aboard NASA's Landsat-4 satellite was examined. The results of performing regressions of over 20 soil properties on the six TM bands indicated that organic matter, water, clay, cation exchange capacity, and calcium were the properties most readily predicted from TM data. The middle infrared bands, bands 5 and 7, were the best bands for predicting soil properties, and the near infrared band, band 4, was nearly as good. Clustering 234 soil samples on the TM bands and characterizing the clusters on the basis of soil properties revealed several clear relationships between properties and reflectance. Discriminant analysis found organic matter, fine sand, base saturation, sand, extractable acidity, and water to be significant in discriminating among clusters. Author

**A85-17526\*** Minnesota Univ., St. Paul.

### **VARIATIONS IN THEMATIC MAPPER SPECTRA OF SOIL RELATED TO TILLAGE AND CROP RESIDUE MANAGEMENT - INITIAL EVALUATION**

M. W. SEELEY, D. L. RUSCHY, and D. R. LINDEN (Minnesota, University; U.S. Department of Agriculture, Agricultural Research Service, St. Paul, MN) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 5 p. Research supported by the U.S. Department of Agriculture and NASA.

A cooperative research project was initiated in 1982 to study differences in thematic mapper spectral characteristics caused by variable tillage and crop residue practices. Initial evaluations of radiometric data suggest that spectral separability of variably tilled soils can be confounded by moisture and weathering effects. Separability of bare tilled soils from those with significant amounts of corn residue is enhanced by wet conditions, but still possible under dry conditions when recent tillage operations have occurred. In addition, thematic mapper data may provide an alternative method to study the radiant energy balance at the soil surface in conjunction with variable tillage systems. Author

**A85-17527**

### **CROP IDENTIFICATION WITH AIRBORNE SCATTEROMETRY**

N. C. MEHTA (Lockheed Engineering and Management Services Co., Inc., Houston, TX) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 6 p.

The ability of active microwave remote sensors to accurately discriminate between agricultural crops is investigated. In particular, the usefulness of a multifrequency multipolarization, multiangle airborne nonimaging radar system for crop separability is studied. Based on a two-class separability measure and using data acquired at three frequencies, two polarizations, and ten incidence angles, it is found that higher frequencies are more useful for discriminating small grains and that lower frequencies tend to separate non-small grains better. Some crops are more separable when row direction is taken into account. The effect of pixel purity is to increase the separability between all crops while not changing the selection of useful scatterometer channels. C.D.

**A85-17528**

### **CROP MOISTURE CONDITION ASSESSMENT WITH PASSIVE MICROWAVE RADIOMETRY**

M. J. MCFARLAND and P. H. HARDER, III (Texas A&M University, College Station, TX) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 5 p. refs

Passive microwave measurements of the Electrically Scanning Microwave Radiometer (ESMR) in Nimbus 5 were correlated with moisture conditions of winter wheat in north central Oklahoma and south central Kansas for the crop seasons of 1973-74 and 1974-75. ESMR brightness temperatures and climatological daily air temperatures and precipitation data were objectively analyzed to a 25 km grid, which matched the nadir resolution of the radiometer. Analysis of the emissivity changes with an antecedent precipitation index indicated that for the major winter wheat areas passive microwave radiometry can be used to determine moisture excesses or deficiencies at fall planting and again in the spring before a full canopy is established. After full canopy establishment, moisture deficits can be identified by interpretation of the temporal trend of emissivities. Author

**A85-17529\*** National Aeronautics and Space Administration. National Space Technology Labs., Bay Saint Louis, Miss.

### **ASSESSMENT OF MSS SPECTRAL INDEXES FOR MONITORING ARID RANGELAND**

H. B. MUSICK (NASA, National Space Technology Laboratories, Earth Resources Laboratory, Bay St. Louis, MS) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 6 p. refs

The utility of MSS spectral indexes for monitoring arid rangeland vegetation was tested by determining correlations between spectral indexes and vegetation parameters and by examining retrospective MSS data to determine if vegetation change could be detected and measured using spectral indexes. MSS Band 5, albedo, and the Kauth-Thomas Brightness component appear to be useful for monitoring total vegetation cover. Multiseasonal green vegetation indexes could be used to estimate changes in the shrub/grass ratio. In retrospective monitoring, spectral index change appeared to be offset from true change, indicating that the methods used to standardize data sets for differences in solar elevation and sensor radiometric response were not completely successful. Author

**A85-17531\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

### **EVALUATION OF LANDSAT THEMATIC MAPPER FOR VEGETATED ALLUVIUM SOILS INFORMATION**

D. R. THOMPSON, K. E. HENDERSON, A. G. HOUSTON, and D. E. PITTS (NASA, Johnson Space Center, Houston, TX) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 5 p. refs

Landsat Thematic Mapper data acquired over Mississippi County, Arkansas, on August 22, 1982, were evaluated whether TM provides information that could be used for soil association maps and if soil properties (variability within vegetated fields) can be detected with the new bands on TM. It was found that TM data - especially the mid-IR and thermal bands - show the capability for separating vegetated soil landscapes on a broad basis. Analysis at the field level with a crop growing indicates that TM, with its additional and narrower bands and improved spatial resolution is influenced by within-field variability due to soils. Author



**A85-17532\*** National Aeronautics and Space Administration. National Space Technology Labs., Bay Saint Louis, Miss.  
**POTENTIAL FOR MONITORING SOIL EROSION FEATURES AND SOIL EROSION MODELING COMPONENTS FROM REMOTELY SENSED DATA**

K. J. LANGRAN (NASA, National Space Technology Laboratories, Earth Resources Laboratory, Bay St. Louis, MS) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 4 p. refs

Accurate estimates of soil erosion and its effects on soil productivity are essential in agricultural decision making and planning from the field scale to the national level. Erosion models have been primarily developed for designing erosion control systems, predicting sediment yield for reservoir design, predicting sediment transport, and simulating water quality. New models proposed are more comprehensive in that the necessary components (hydrology, erosion-sedimentation, nutrient cycling, tillage, etc.) are linked in a model appropriate for studying the erosion-productivity problem. Recent developments in remote sensing systems, such as Landsat Thematic Mapper, Shuttle Imaging Radar (SIR-B), etc., can contribute significantly to the future development and operational use of these models. Author

**A85-17534**

**SPATIAL VARIABILITY OF MEDITERRANEAN WOODLANDS AS DEDUCED FROM LANDSAT AND GROUND MEASUREMENTS**

B. LACAZE, G. DEBUSSCHE, and J. JARDEL (CNRS, Centre d'Etudes Phytosociologiques et Ecologiques, Montpellier, France) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 5 p. Research supported by the Centre National d'Etudes Spatiales and Centre National de la Recherche Scientifique. refs

An attempt is made to quantify the spatial variability of dominant woodland evergreen and deciduous coppices in southern France, using energy coefficients derived from a pseudo-Hadamard transform of Landsat data studied at five dates in the winter, summer, and fall. The results obtained imply a generalized macroheterogeneity of mapped units. Although internal contrast is higher for Multispectral Scanner channels 6 and 7, apparently in virtue of topographical variations, maximum contrast can be affected by climatic conditions and was observed at the end of the driest period. Remotely sensed spatial patterns are suggested to be more dependent on topography and vegetation stress than mean vegetation cover and species dominance. O.C.

**A85-17535**

**MAPPING FIRE BURNS AND VEGETATION REGENERATION USING PRINCIPAL COMPONENTS ANALYSIS**

J. A. RICHARDS and A. K. MILNE (New South Wales, University, Kensington, Australia) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 6 p.

Principal components transformation analyses generate a spectral representation in which data exhibits maximum variance along the first principal axis with successively decreasing variances along remaining orthogonal axes. It is also a useful technique for highlighting regions of major localized change in multitemporal imagery. Global regions which change little from one image to another in a multitemporal sequence are highly correlated in the combined multispectral space of the data. This type of analysis is presently evaluated for bush fire mapping and the subsequent regeneration of vegetation. The technique is demonstrated for the cases of two fires in the vicinity of Sydney, New South Wales, Australia. O.C.

**A85-17547\*** Lockheed Engineering and Management Services Co., Inc., Houston, Tex.

**SIMULATIONS AS A TOOL FOR EVALUATING LANDSAT-BASED CROP AREA ESTIMATION SYSTEMS**

D. B. RAMEY, J. H. SMITH (Lockheed Engineering and Management Services Co., Inc., Houston, TX), and J. L. DRAGG (NASA, Johnson Space Center, Earth Resources Applications Div., Houston, TX) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 4 p. refs (Contract NAS9-15800)

An important use of remotely sensed data is in the estimation of agricultural production in foreign areas. Evaluation of such production estimates is difficult because of the lack of independent crop inventories. This paper presents simulation software developed to assess the effects of various factors on the performance of Landsat-based agricultural crop area estimators. An application of the simulator to determine whether the interaction of weather cycles with the Landsat orbital period could induce a systematic bias in large area crop estimates is discussed in detail. The simulation study was performed for the spring grains growing region of the Soviet Union. Author

**A85-17548\*** Technicolor Government Services, Inc., Moffett Field, Calif.

**FEATURE SELECTION AND INFORMATION CONTENT OF THEMATIC MAPPER SIMULATOR DATA FOR A FORESTED ENVIRONMENT**

M. A. SPANNER (Technicolor Government Services, Inc., Moffett Field, CA), J. A. BRASS, and D. L. PETERSON (NASA, Ames Research Center, Moffett Field, CA) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 9 p. refs

Feature selection and the information content of Thematic Mapper Simulator (TMS) data are investigated for a forested region in northern Idaho. The optimal TMS channels for forest structural characteristics are determined, and the capability of TMS data to describe the structural variability within a forest stand is evaluated. The comparative performance of TMS and MSS data to discriminate forest structural factors using per-pixel maximum likelihood classification is examined, and four optimal TMS channels are classified in order to ascertain if the full complement of TM channels provide higher accuracies than the four optimal ones. C.D.

**A85-17554\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

**A SUMMARY OF THE HISTORY OF THE DEVELOPMENT OF AUTOMATED REMOTE SENSING FOR AGRICULTURAL APPLICATIONS**

R. B. MACDONALD (NASA, Johnson Space Center, Houston, TX) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 8 p. refs

The research conducted in the United States for the past 20 years with the objective of developing automated satellite remote sensing for monitoring the earth's major food crops is reviewed. The highlights of this research include a National Academy of Science study on the applicability of remote sensing monitoring given impetus by the introduction in the mid-1960's of the first airborne multispectral scanner (MSS); design simulations for the first earth resource satellite in 1969; and the use of the airborne MSS in the Corn Blight Watch, the first large application of remote sensing in agriculture, in 1970. Other programs discussed include the CITAR research project in 1972 which established the feasibility of automating digital classification to process high volumes of Landsat MSS data; the Large Area Crop Inventory Experiment (LACIE) in 1974-78, which demonstrated automated processing of Landsat MSS data in estimating wheat crop production on a global

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basis; and AgRISTARS, a program designed to address the technical issues defined by LACIE. V.L.

**A85-17556\*** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

### **PRELIMINARY AIRBORNE IMAGING SPECTROMETER VEGETATION DATA**

B. N. ROCK (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 4 p. NASA-supported research. refs

An airborne, pushbroom-style multispectral (1.2-2.4 micron) imaging sensor system known as Airborne Imaging Spectrometer (AIS) has been flown over the Pico Anticline region of the Santa Susana Mountains, California (U.S.A.). Initial interpretation of preliminary data sets suggest that the high spectral resolution data from AIS provide superior vegetation discrimination and mapping capabilities when compared with other imaging systems (MSS, TMS). AIS spectral data may also contain information concerning the state of health of both native and cultivated vegetation. Such capabilities (discrimination, mapping, and assessment of state of health) will be most useful in geobotanical assessment of this and other areas. Author

**A85-17557\*** Lockheed Engineering and Management Services Co., Inc., Houston, Tex.

### **EARLY SEASON SPRING SMALL GRAINS DIRECT PROPORTION ESTIMATION - DEVELOPMENT AND EVALUATION OF A LANDSAT BASED METHODOLOGY**

D. E. PHINNEY (Lockheed Engineering and Management Services Co., Inc., Houston, TX) and M. C. TRICHEL (NASA, Johnson Space Center, Houston, TX) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 6 p. refs

(Contract NAS9-15800)

The Inventory Technology Development (ITD) project of the Agriculture and Resources Inventory Surveys Through Aerospace Remote Sensing (AgRISTARS) program has developed an accurate, automated technology for early season estimation of spring small grains areal proportion from Landsat MSS data. The design criteria for an early season procedure included estimates available within the first 30 days of the growing season, low data processing/preprocessing requirements, and no need for scene-to-scene registration. The prototype estimator which meets the design goals is based on a constrained linear model in which the observed spectral response of an entire scene is modeled as a linear combination of the major constituent elements in the scene. The procedure was evaluated over 100 sample segments collected for crop years 1976 through 1979 in the U.S. Northern Great Plains. Analysis of the test results indicated accuracy that compare favorably with both the automated at-harvest technologies tested during the FY81-82 AgRISTARS Spring Small Grains Pilot experiments and earlier analyst-intensive at-harvest technologies. Author

**A85-17558\*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

### **DEVELOPMENT OF VISIBLE/INFRARED/MICROWAVE AGRICULTURE CLASSIFICATION AND BIOMASS ESTIMATION ALGORITHMS**

W. D. ROSENTHAL (Blackland Research Center, Temple, TX), B. J. BLANCHARD (NASA, Goddard Space Flight Center, Greenbelt, MD), and A. J. BLANCHARD (Texas A&M University, College Station, TX) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 7 p. refs (Contract NSG-5134)

This paper describes the results of a study to determine if crop acreage and biomass estimates could be improved by using visible IR and microwave data. The objectives were to (1) develop and test agricultural crop classification models using two or more spectral regions (visible through microwave), and (2) estimate biomass by including microwave with visible and infrared data. Aircraft multispectral data collected during the study included visible and infrared data (multiband data from 0.5 m - 12 m), and active microwave data K band (2 cm), C band (6 cm), L band (20 cm), and P band (75 cm) HH and HV polarizations. Ground truth data from each field consisted of soil moisture and biomass measurements. Results indicated that C, L, and P band active microwave data combined with visible and infrared data improved crop discrimination and biomass estimates compared to results using only visible and infrared data. The active microwave frequencies were sensitive to different biomass levels; K and C being sensitive to differences at low biomass levels, while P band was sensitive to differences at high biomass levels. Author

**A85-17559**

### **MULTISTAGE REMOTE SENSING AND FIELD RESEARCH IN NORTHERN KENYA**

H. R. GOETTING and R. P. WINTER (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, West Germany) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 2 p. refs

The natural vegetation of semi-arid rangeland in Northern Kenya's Samburu District and the impact on it by men and domestic animals is described. Geographical and botanical field measurements in the dry (1982) and in the growing season (1983) are used. Remote sensing methods are applied in three steps: low- and high-altitude aircraft photography and digital image processing of time serial Landsat data. Author

**A85-17571\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

### **A SURVEY OF AUTOMATED REMOTE SENSING FOR AGRICULTURE**

F. G. HALL and R. B. MACDONALD (NASA, Johnson Space Center, Houston, TX) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 12 p. refs

The state-of-the-art of the technology available to make remote sensing crop production estimates is reviewed with reference to several past and present research projects. In particular, attention is given to Landsat data acquisition, registration and preprocessing, data transformation, data modeling, proportion estimation, and labeling. Development stage models and crop condition models are briefly characterized, and areas where further research is needed are identified. V.L.

**A85-17598\*** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**ON THE USE OF POLARIZED RADAR MEASUREMENTS FOR VEGETATION STUDIES**

J. F. PARIS (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 4 p. refs

(Contract NAS7-100)

Radar engineers have used several polarization combinations (HH, HV, VV, and/or VH) in the design of radar imagers and scatterometers for remote sensing research and applications. Scientists have explored their use for vegetation identification, mapping, and canopy condition assessment. In some cases, one polarization combination or another has produced good results; however, the results have not been consistent. In this paper, the use of polarized radar measurements is considered for vegetation studies on a theoretical basis to define ways of isolating parameters related to canopy structure and composition in the presence of backscattering from the underlying surface. It is found that scientists should use all three polarization combinations (VV, HH, and VH or HV) and their ratios. Author

**A85-17599\*** National Aeronautics and Space Administration. National Space Technology Labs., Bay Saint Louis, Miss.

**ANALYSIS OF SYNTHETIC APERTURE RADAR DATA ACQUIRED OVER A VARIETY OF LAND COVER**

S. T. WU (NASA, National Space Technology Laboratories, Earth Resources Laboratory, Bay St. Louis, MS) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 6 p. refs

An analysis has been conducted of two-look-angle, multipolarization X-band SAR results. On the basis of the variety of land covers studied, the vertical-vertical polarization (VV) data is judged to contain the highest degree of contrast, while the horizontal-vertical (HV) polarization contained the least. VV polarization data is accordingly recommended for forest vegetation classification in those cases where only one data channel is available. The inclusion of horizontal-horizontal polarization data, however, is noted to be capable of delineating special surface features. O.C.

**A85-17600\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

**SHUTTLE IMAGING RADAR-A (SIR-A) DATA AS A COMPLEMENT TO LANDSAT MULTISPECTRAL SCANNER (MSS) DATA**

D. L. HENNINGER and J. H. CARNEY (NASA, Johnson Space Center, Earth Sciences and Applications Div., Houston, TX) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 6 p.

Principal components analysis and supervised classifications were performed on two dates of Landsat multispectral scanner (MSS) data registered to one date of Shuttle Imaging Radar-A (SIR-A) data in a wheat-growing area of New South Wales, Australia. The purpose was to evaluate SIR-A data as a complement to Landsat MSS data in an agricultural environment. The SIR-A data was filtered using a 7 x 7 pixel moving window median filter. Principal components analysis indicated the SIR-A data were discriminating between trees and agricultural fields. Supervised classifications using wheat, pasture, trees, and idle classes resulted in increased accuracies for wheat and pasture and slightly decreased accuracies for trees and idle for the Landsat MSS/SIR-A registered data sets over the Landsat MSS alone. Overall classification accuracies were unchanged for one date and substantially increased for the other when the SIR-A data were added to the Landsat MSS data. Author

**A85-17758\*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**OPTIMAL DIRECTIONAL VIEW ANGLES FOR REMOTE-SENSING MISSIONS**

D. S. KIMES, B. N. HOLBEN, C. J. TUCKER (NASA, Goddard Space Flight Center, Earth Resources Branch, Greenbelt, MD), and W. W. NEWCOMB (Republic Management Systems, Inc., Landover, MD) International Journal of Remote Sensing (ISSN 0143-1161), vol. 5, Nov.-Dec. 1984, p. 887-908. refs

The present investigation is concerned with the directional, off-nadir viewing of terrestrial scenes using remote-sensing systems from aircraft and satellite platforms, taking into account advantages of such an approach over strictly nadir viewing systems. Directional reflectance data collected for bare soil and several different vegetation canopies in NOAA-7 AVHRR bands 1 and 2 were analyzed. Optimum view angles were recommended for two strategies. The first strategy views the utility of off-nadir measurements as extending spatial and temporal coverage of the target area. The second strategy views the utility of off-nadir measurements as providing additional information about the physical characteristics of the target. Conclusions regarding the two strategies are discussed. G.R.

**A85-18452**

**USE OF LANDSAT RADIANCE PARAMETERS TO DISTINGUISH SOIL EROSION, STABILITY, AND DEPOSITION IN ARID CENTRAL AUSTRALIA**

G. PICKUP and D. J. NELSON (Commonwealth Scientific and Industrial Research Organization, Div. of Wildlife and Rangelands Research, Alice Springs, Australia) Remote Sensing of Environment (ISSN 0034-4257), vol. 16, Dec. 1984, p. 195-209. refs

**A85-18454**

**EFFECT OF SOIL BACKGROUND ON VEGETATION DISCRIMINATION USING LANDSAT DATA**

C. E. EZRA (EG&G Energy Measurements, Inc., Las Vegas, NV; U.S. Department of Agriculture, Water Conservation Laboratory, Phoenix, AZ), L. R. TINNEY (EG&G Energy Measurements, Inc., Las Vegas, NV), and R. D. JACKSON (U.S. Department of Agriculture, Water Conservation Laboratory, Phoenix, AZ) Remote Sensing of Environment (ISSN 0034-4257), vol. 16, Dec. 1984, p. 233-242. refs

Digital count values were extracted for wet and dry areas within three spectrally different soil types from a 21 March 1977 Landsat-2 scene over the southern Central Valley of California. These values were converted to brightness and greenness using the global Kauth-Thomas coefficients. Greenness was scaled using the Kauth-Thomas soil line as the 0 percent level and a full cover wheat canopy greenness point as 100 percent. Individual site specific soil lines were then compared. The total difference in greenness among the three test soils ranged up to 14.5 percent using the global Kauth-Thomas coefficients. Site-specific soil lines were then calculated using soil specific coefficients. The difference among the three test soils was reduced from 14.5 percent to 3.8 percent. These results indicate that soil background effects can be significant in Landsat data but can be reduced using site specific soil information. Author

**A85-18456**

**MICROWAVE REMOTE SENSING OF PLANT WATER STRESS**

S. PALOSCIA and P. PAMPALONI (CNR, Istituto di Analisi Ambientale e Telerilevamento Applicati all'Agricoltura, Florence, Italy) Remote Sensing of Environment (ISSN 0034-4257), vol. 16, Dec. 1984, p. 249-255. Research supported by the Consiglio Nazionale delle Ricerche. refs

The sensitivity of microwave (MW) emission to physical conditions of vegetation has been assessed by means of ground-based microwave and infrared radiometers. Measurements on corn and wheat have shown an inverse correlation between the normalized brightness temperature (TN) from the Ka band (36 GHz) and the atmospheric water vapor pressure (VP) at the top of vegetation. From this observation, it is shown that a crop water

stress index can be calculated by means of down-looking MW sensors, provided air temperature is known. A polarization index (PI) dependent only on microwave measurements was shown to be related to crop water stress. Author

## **A85-18640\*** Los Alamos Scientific Lab., N. Mex. **COUPLED ATMOSPHERE/CANOPY MODEL FOR REMOTE SENSING OF PLANT REFLECTANCE FEATURES**

S. A. GERSTL and A. ZARDECKI (Los Alamos National Laboratory, Los Alamos, NM) Applied Optics (ISSN 0003-6935), vol. 24, Jan. 1, 1985, p. 94-103. refs  
(Contract NASA ORDER S-10786-C)

Solar radiative transfer through a coupled system of atmosphere and plant canopy is modeled as a multiple-scattering problem through a layered medium of random scatterers. The radiative transfer equation is solved by the discrete-ordinates finite-element method. Analytic expressions are derived that allow the calculation of scattering and absorption cross sections for any plant canopy layer form measurable biophysical parameters such as the leaf area index, leaf angle distribution, and individual leaf reflectance and transmittance data. An expression for a canopy scattering phase function is also given. Computational results are in good agreement with spectral reflectance measurements directly above a soybean canopy, and the concept of greenness- and brightness-transforms of Landsat MSS data is reconfirmed with the computed results. A sensitivity analysis with the coupled atmosphere/canopy model quantifies how satellite-sensed spectral radiances are affected by increased atmospheric aerosols, by varying leaf area index, by anisotropic leaf scattering, and by non-Lambertian soil boundary conditions. Possible extensions to a 2-D model are also discussed. Author

## **A85-19241** **EFFECTS OF THE LASER FIELD ON AN INHOMOGENEITY WAVE IN THE ACTIVE MEDIUM OF AN IODINE PHOTODISSOCIATION LASER**

V. S. ZUEV, K. S. KOROLKOV, O. I. NOSACH, and E. P. ORLOV (Akademii Nauk SSSR, Fizicheskii Institut, Moscow, USSR) (Kvantovaya Elektronika /Moscow/, vol. 11, July 1984, p. 1465-1467) Soviet Journal of Quantum Electronics (ISSN 0049-1748), vol. 14, July 1984, p. 988-990. Translation. refs

The laser field was found to affect the profile of the refractive index  $n$  in an inhomogeneity wave in a flashlamp-pumped iodine photodissociation laser. The laser field produced a dip of depth  $\Delta n(g)$  in the profile of  $n$  in the inhomogeneity wave, and this increased  $\Delta n$  in the wave by up to an order of magnitude. An analogy was established between the mechanisms of the effect of the laser field on an inhomogeneity wave and the process of stimulated enthalpy scattering. A correlation was found between  $\Delta n(g)$  and the transient gain in stimulated enthalpy scattering in various buffer gases. Author

## **A85-24724** **NORMALIZED LOWEST INTERMOD MIXER BANDWIDTH DESIGN CURVES SPEED CHOICE OF FREQUENCIES FOR EW UP/DOWN CONVERTERS**

D. NEUF and P. PIRO (RHG Electronics Laboratory, Inc., Deer Park, NY) Microwave Journal (ISSN 0026-2897), vol. 28, Feb. 1985, p. 165-173. refs

## **N85-11029\*#** Alabama A & M Univ., Normal. **AGRIBUSINESS AND SPACE: NO LIMITS TO GROWTH** O. L. MONTGOMERY and C. T. N. PALUDAN (Tennessee Univ. Space Inst., Tullahoma) In NASA. Marshall Space Flight Center 2nd Symp. on Space Industrialization p 110-119 Oct. 1984 refs

Avail: NTIS HC A19/MF A01 CSCL 20C  
Technological developments responding to world food needs are examined. It is noted that agribusiness technology has become more space-related in recent years. Although crops forecasting and improvements in yield (the green revolution) were developed prior to the space era, it would be unthinkable today to ignore the contributions of operational meteorological and communications

satellites and experimental Earth observation satellites in agribusiness. Space-driven communications now permit national agribusiness database management networks, with a significant portion of the data being space-derived. In demonstration experiments, space communications were shown to improve those aspects of the food problem related to education and author communications. Author

## **N85-11334#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

## **MULTISPECTRAL PASSIVE MICROWAVE CORRELATIONS WITH AN ANTECEDENT PRECIPITATION INDEX USING THE NIMBUS 7 SMMR M.S. Thesis**

G. D. WILKE Aug. 1984 144 p  
(AD-A145419; AFIT/CI/NR-84-61T) Avail: NTIS HC A07/MF A01 CSCL 14B

Analysis of the passive microwave brightness temperatures from the Scanning Multichannel Microwave Radiometer (SMMR) aboard Nimbus 7 can infer soil moisture through an Antecedent Precipitation Index (API). This investigation involves correlation analysis between five passive microwave brightness temperature wavelengths (0.81, 1.36, 1.66, 2.80, and 4.54 cm) in two polarizations spanning a one year period. Data analysis was done by a temporal and areal approach, for both the normalized brightness temperatures and the differences in the polarized channels, for all five SMMR wavelengths. Three transformations of the polarized brightness temperatures were used to evaluate the ability of the microwave data to infer soil moisture through correlations with the API. Author (GRA)

## **N85-11402** Oregon State Univ., Corvallis. **RELATIONSHIPS BETWEEN GRASS CANOPY CHARACTERISTICS AND LANDSAT THEMATIC MAPPER BANDS Ph.D. Thesis**

W. J. RIPPLE 1984 122 p  
Avail: Univ. Microfilms Order No. DA8415292

The relationships between spectral reflectance in the LANDSAT Thematic Mapper (TM) bands and grass canopy variables were evaluated using in situ remote sensing techniques. Reflectance data were collected from experimental plots of annual ryegrass (*Lolium multiflorum*) and tall fescue (*Festuca arundinacea*) using a Barnes Modular Multiband Radiometer (MMR). The canopy variables used were canopy height, canopy cover, total wet biomass, total dry biomass, above-ground plant water, and leaf area index. Statistically significant relationships were found between the spectral bands and the canopy variables. Inverse relationships in the visible (TM1, TM2, TM3) and middle infrared (TM5, TM7) regions were related to spectral absorption by plant pigments (visible) and moisture within plant tissue (middle infrared). Direct relationships in the near infrared (TM4, MMR5) were attributed to enhanced reflectance resulting from spectral scattering. Overall, no one spectral band was found to be superior in all situations, but TM5 consistently showed the lowest correlations with the canopy variables. Dissert. Abstr.

## **N85-11407\*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md. **BOTANICAL SCIENCES TEAM Final Report** In its The Multispectral Imaging Sci. Working Group, Vol. 2 p 63-104 7 Sep. 1982 refs ERTS Avail: NTIS HC A15/MF A01 CSCL 05B

Improvements in vegetation monitoring and mapping which would result from increased spectral and spatial resolution in multispectral systems are discussed. Current knowledge of the spectral properties of vegetation is reviewed and areas where existing knowledge is incomplete are identified. In addition, the effects of the atmosphere on the remote sensing of vegetation are examined. M.G.

**N85-11418\*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

**A PRELIMINARY STUDY OF THE FEASIBILITY OF DETECTING THE FLOATING MACROPHYTES BY MEANS OF DIGITAL PROCESSING OF MSS/LANDSAT DATA [ESTUDO PRELIMINAR SOBRE A VIABILIDADE DE DETECCAO DE MACROFITAS FLUTUANTES ATRAVES DE PROCESSAMENTO DIGITAL DE DADOS DO MSS/LANDSAT]**

D. D. VALERIANO, Principal Investigator Aug. 1984 16 p refs In PORTUGUESE; ENGLISH summary Presented at the 3rd Simp. Brasileiro de Sensoriamento Remoto, Rio de Janeiro, 28-30 Nov. 1984 Sponsored by NASA Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS (E85-10005; NASA-CR-174031; NAS 1.26:174031; INPE-3228-PRE/579) Avail: NTIS HC A02/MF A01 CSCL 05B

The feasibility of mapping the floating macrophytes (mostly water hyacinth: (*Eichornia crassipes*) in the Salto Grande reservoir in Americana, SP, by means of digital processing of MSS/LANDSAT data is described. The area occupied by the macrophytes was extracted by exclusion after the merging of two thematic masks representing the area of vegetation free water surface. One of the masks was obtained from a date when the vegetal cover is insignificant, while the other represents a large infestation episode. The utilization of digital processing of MSS/LANDSAT data techniques for the documentation of macrophytes infestation is feasible only when the phenomenon occurs in large areas.

Author

**N85-11419\*#** Aster Consulting Associates, Binghamton, N.Y. **BIOPHYSICAL AND SPECTRAL MODELING FOR CROP IDENTIFICATION AND ASSESSMENT Final Report**

N. S. GOEL, Principal Investigator 15 Sep. 1984 31 p ERTS (Contract NAS9-16873) (E85-10006; NASA-CR-171813; NAS 1.26:171813) Avail: NTIS HC A03/MF A01 CSCL 02C

The development of a technique for estimating all canopy parameters occurring in a canopy reflectance model from the measured canopy reflectance data is summarized. The Suits and the SAIL model for a uniform and homogeneous crop canopy were used to determine if the leaf area index and the leaf angle distribution could be estimated. Optimal solar/view angles for measuring CR were also investigated. The use of CR in many wavelengths or spectral bands and of linear and nonlinear transforms of CRs for various solar/view angles and various spectral bands is discussed as well as the inversion of radiance data inside the canopy, angle transforms for filtering out terrain slope effects, and modification of one dimensional models.

A.R.H.

**N85-11422\*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

**UTILIZATION OF LANDSAT ORBITAL IMAGERY IN THE SOIL SURVEY PROCESSES AT RIO GRANDE DO NORTE STATE [UTILIZACAO DE IMAGENS ORBITAIS LANDSAT PARA LEVANTAMENTO DE SOLOS NO ESTADO DO RIO GRANDE DO NORTE]**

A. R. FORMAGGIO, Principal Investigator Sep. 1984 28 p In PORTUGUESE; ENGLISH summary Presented at GEOTEC 1, Rio de Janeiro, Nov. 1983 Sponsored by NASA ERTS (E85-10009; NASA-CR-168566; NAS 1.26:168566; INPE-3270-RPE/465) Avail: NTIS HC A03/MF A01 CSCL 05B

Pedologic photointerpretative criteria adapted to LANDSAT orbital imagery were used: drainage (pattern, integration degree, density and uniformity degree); relief (pattern, dissection degree and crest lines); photographic texture, photographic tonality, and the land use (type, glebas size and intensity of use). The performance of the imagery as an auxiliar tool in the soil survey processes, at Rio Grande do Norte State was evaluated. The drainage and relief elements were easily extracted from the imagery and also ones that provided the greatest deductive possibility about

pedologic boundaries. Other analyzed criteria were considered only auxiliaries, corroborating some soil limits in the evidences convergence phase. The principal pedologic dominions of the 30,000 sq km are covered by the same LANDSAT image (WRS 359/16) were delimited with good precision: (1) fluvial plains, beaches, dunes and coastal mangroves; (2) North Coast line Plateau; (3) Acu Sandstone Zone; (4) residual plateaus of the Tertiary; and (6) plains of the embasement. Author

**N85-11424\*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

**EXECUTIVE REPORT: RESULTS OF THE IRGA-CNPQ/INPE EXPERIMENTAL PROJECT [RELATORIO EXECUTIVO: RESULTADOS DO PROJETO EXPERIMENTAL IRGA-CNPQ/INPE]**

G. V. DEASSUNCAO, Principal Investigator, R. A. NOVAES, and M. A. MOREIRA Oct. 1983 70 p In PORTUGUESE; ENGLISH summary Sponsored by NASA Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS (E85-10011; NASA-CR-168568; NAS 1.26:168568; INPE-2939-RPE/446) Avail: NTIS HC A04/MF A01 CSCL 02F

A methodology for identifying and evaluating crop area with irrigated rice is described, using MSS-LANDSAT data. The maps of the spatial rice crop areas in the studied region are presented. The calculation of rice growing area from the LANDSAT images are included. M.A.C.

**N85-11425\*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

**REMOTE SENSING APPLIED TO FOREST RESOURCES [SENSORES REMOTOS EM LEVANTAMENTOS FLORESTAIS]**

P. HERNANDEZFILHO, Principal Investigator Jul. 1984 27 p refs In PORTUGUESE; ENGLISH summary Presented at the 2nd Simposio sobre Inventario Florestal, Piracicaba, Brazil, 15-16 Aug. 1984 Sponsored by NASA ERTS (E85-10012; NASA-CR-168569; NAS 1.26:168569; INPE-3167-PRE/537) Avail: NTIS HC A03/MF A01

The development of methodologies to classify reforested areas using remotely sensed data is discussed. A preliminary study was carried out in northeast of the Sao Paulo State in 1978. The reforested areas of *Pinus* spp and *Eucalyptus* spp were based on the spectral, spatial and temporal characteristics fo LANDSAT imagery. Afterwards, a more detailed study was carried out in the Mato Grosso do Sul State. The reforested areas were mapped in functions of the age (from: 0 to 1 year, 1 to 2 years, 2 to 3 years, 3 to 4 years, 4 to 5 years and 5 to 6 years) and of the heterogeneity stand (from: 0 to 20%, 20 to 40%, 40 to 60%, 60 to 80% and 80 to 100%). The relative differences between the artificial forest areas, estimated from LANDSAT data and ground information, varied from -8.72 to +9.49%. The estimation of forest volume through a multistage sampling technique, with probability proportional to size, is also discussed. M.A.C.

**N85-11429\*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

**BASIC PRINCIPLES, METHODOLOGY, AND APPLICATIONS OF REMOTE SENSING IN AGRICULTURE [PRINCIPIOS BASICOS, METODOLOGIAS E APLICACOES DE SENSORIAMENTO REMOTO NA AGRICULTURA]**

M. A. MOREIRA, Principal Investigator and G. V. DEASSUNCAO Jul. 1984 70 p refs In PORTUGUESE; ENGLISH summary Sponsored by NASA ERTS (E85-10016; NASA-CR-168573; NAS 1.26:168573; INPE-3199-MD/027) Avail: NTIS HC A04/MF A01 CSCL 02C

The basic principles of remote sensing applied to agriculture and the methods used in data analysis are described. Emphasis is placed on the importance of developing a methodology that may help crop forecast, basic concepts of spectral signatures of vegetation, the methodology of the LANDSAT data utilization in agriculture, and the remote sensing program application of INPE (Institute for Space Research) in agriculture. M.A.C.

**N85-11431\*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

**DEVELOPMENT AND TESTING OF A RURAL CREDIT SUPERVISION SYSTEM AT THE LEVEL OF COUNTIES AND RURAL PROPERTIES UTILIZING REMOTE SENSING TECHNIQUES [DESENVOLVIMENTO E TESTE DE UM SISTEMA DE FISCALI ZACAO DAS OPERACOES DE CREDITO AGRICOLA AO NIVEL DE MUNICIPIO E DE PROPRIEDADES AGRICOLAS UTILIZANDO TECNICAS DE SENSORIAMENTO REMOTO]**

G. T. BATISTA, Principal Investigator, A. M. DELIMA, A. T. TARDIN, B. F. T. RUDORFF, F. J. MENDONCA, S. DOSANJOSFERREIRAPINTO, S. C. CHEN, and V. DUARTE Aug. 1984 116 p refs In PORTUGUESE; ENGLISH summary Sponsored by NASA ERTS

(E85-10018; NASA-CR-168575; NAS 1.26:168575; INPE-3239-RPE/462) Avail: NTIS HC A06/MF A01 CSCL 05B

Remote sensing techniques for supporting the rural credit supervision system were developed and tested. The test area comprised the counties of Aracatuba and Guararapes, located in the State of Sao Paulo. Aerial photography, LANDSAT images and topographic charts were used. Aerial photographs were extremely useful for the out lining of properties boundaries with financing of sugarcane plantations by the Banco do Brasil S.A.. The percentage of correctly interpreted sugarcane on LANDSAT images, considering the 85 analyzed properties, was of 63.12%. The occurrence of atypical conditions such as excessive raining, sugarcane in bloom, and wind damaged sugarcane and sugarcane not harvested due to planning failures verified during the period the images were obtained, were some of the contributing factors associated with a low interpretation performance. An alternative approach was developed using several LANDSAT overpasses and auxiliary field data, which resulted in 91.77 percent correct.

Author

**N85-11437\*#** Columbia Univ., New York. Dept. of Geography. **APPLICATION OF DIGITAL ANALYSIS OF MSS TO AGRO-ENVIRONMENTAL STUDIES Final Technical Report**

S. N. GOWARD and R. A. LEWIS, Principal Investigators 30 Sep. 1983 4 p ERTS

(Contract NCC5-20) (E85-10024; NASA-CR-174047; NAS 1.26:174047) Avail: NTIS HC A02/MF A01 CSCL 05B

Topics of investigation include infrared analysis of vegetation canopies, urban/rural albedo studies, analysis of Field Spectrometer System (ESS) observations, geometric and radiometric processing techniques of aircraft MSS data, and the use of LANDSAT MSS observations to map wetlands and snow cover.

M.A.C.

**N85-12410** Cornell Univ., Ithaca, N.Y. **REMOTE SENSING FOR LANDFORMS AND SOILS IN THE ARID SOUTHWEST UNITED STATES Ph.D. Thesis**

W. L. TENG 1984 404 p

Avail: Univ. Microfilms Order No. DA8415424

This study was conducted to refine the genetic or landform approach to terrain analysis for soils investigations in the Las Cruces area of New Mexico, by characterizing in a more detailed and explicit manner the image interpretation elements for landform analysis (i.e., boundary, topography, drainage, erosion, tone, and vegetation/land use). Landform units were visually interpreted from 1:40,000 scale panchromatic and 1:112,000 scale color airphotos with stereoscopes, and from LANDSAT multispectral scanner (MSS) images through color active viewing. The delineated units were compared with each other and with published soil survey mapping units, using a geographic information system (Map Analysis Package). Based on the comparison results and field data, the generally accepted landform units in arid regions (i.e., alluvial fan, filled valley, playa, and sand dune) were subdivided into 23 refined units. Delineations from both scales of airphotos generally agreed well with each other and both generally agreed with delineations from soil survey maps.

Dissert. Abstr.

**N85-13364\*#** Kansas Univ. Center for Research, Inc., Lawrence. Remote Sensing Lab.

**A COMPARISON BETWEEN ACTIVE AND PASSIVE SENSING OF SOIL MOISTURE FROM VEGETATED TERRAINS Final Report**

A. K. FUNG and H. J. EOM In *its* Scattering Models in the Microwave Regime 35 p Oct. 1984 refs

Avail: NTIS HC A04/MF A01 CSCL 05B

A comparison between active and passive sensing of soil moisture over vegetated areas is studied via scattering models. In active sensing three contributing terms to radar backscattering can be identified: (1) the ground surface scatter term; (2) the volume scatter term representing scattering from the vegetation layer; and (3) the surface volume scatter term accounting for scattering from both surface and volume. In emission three sources of contribution can also be identified: (1) surface emission; (2) upward volume emission from the vegetation layer; and (3) downward volume emission scattered upward by the ground surface. As ground moisture increases, terms (1) and (3) increase due to increase in permittivity in the active case. However, in passive sensing, term (1) decreases but term (3) increases for the same reason. This self compensating effect produces a loss in sensitivity to change in ground moisture. Furthermore, emission from vegetation may be larger than that from the ground. Hence, the presence of vegetation layer causes a much greater loss of sensitivity to passive than active sensing of soil moisture.

M.G.

**N85-13459#** Joint Publications Research Service, Arlington, Va. **SOME PRINCIPLES OF PLANT RESOURCES EVALUATION USING REMOTELY SENSED DATA**

S. M. GOROZHANKINA and V. D. KONSTANTINOV In *its* USSR Rept.: Life Sci.: Biomed. and Behavioral Sci. (JPRS-UBB-84-026) p 3-18 5 Dec. 1984 refs Transl. into ENGLISH from Rastitelnyye Resursy (Leningrad), v. 20, no. 3, 1984 p 297-307

Avail: NTIS HC A08

The exploitation of natural resources which includes development of a scientifically based method to evaluate and calculate nonligneous forest resources is discussed. The data of forest resources inventorization are very scanty with respect to plants of the herbaceous and shrub classes of the plant kingdom. The need for an efficient study of the geography and ecology of exploitable nonligneous species, based on the principle that characteristics of their development and dispersal are intimately linked to the structure of the ground cover as biogeocenosis at all organizational levels is emphasized. The dispersal areas and the determination of reserves and the seasonal dynamics of nonligneous plant production and the characteristics of soils and the plant cover are studied. Stationary observations must be combined with consistent substantiation of data obtained extraterrestrially by use of remote sensing photography.

E.A.K.

**N85-14211\*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**MONITORING AND MAPPING GLOBAL VEGETATION COVER USING DATA FROM METEOROLOGICAL SATELLITES**

J. R. G. TOWNSHEND (Reading Univ., England), C. O. JUSTICE (Maryland Univ., College Park), B. HOLBEN, and C. TUCKER In ESA EARSeL/ESA Symp. on Integrative Approaches in Remote Sensing p 75-79 Aug. 1984 refs

Avail: NTIS HC A17/MF A01

The role of coarse resolution meteorological satellite data for monitoring and mapping of vegetation for global, continental and regional scales is outlined. In the NOAA products used the effects of cloud cover are reduced by the generation of temporal composites of images of the normalized difference vegetation index. Different land cover types are shown to have characteristic spectral phenological curves. Such data have the disadvantage of effectively increasing the apparent areal extent of small areas of green vegetation.

Author (ESA)



**N85-14213#** Institute for Land and Water Management Research, Wageningen (Netherlands).

**THE AREAL PATTERN OF LATENT AND SENSIBLE HEAT FLUXES: THE COMBINATION OF SOIL PHYSICS AND REMOTELY SENSED DATA**

M. MENENTI /In ESA EARSeL/ESA Symp. on Integrative Approaches in Remote Sensing p 89-96 Aug. 1984 refs  
 Avail: NTIS HC A17/MF A01

It is shown that the use of satellite data to study the surface energy balance becomes easier when any given pixel of the involved satellite images can be assigned to either a class with evaporation taking place below the soil surface, or to a class with surface evaporation. A definition of evaporation front, related to the physical character of vapor flow within pores having a radius comparable with the mean free path of water vapor is proposed. According to this definition the soil water content at the evaporation front can be calculated for each soil type. A relationship between surface moisture content and surface reflectance is given to calculate the threshold reflectance corresponding to the soil water content at the evaporation front. A reflectance map, calculated from satellite data, can be applied to establish whether in a given pixel evaporation takes place at the surface. Author (ESA)

**N85-14214#** Forestry Commission, Farnham (England).  
**FOREST COVER MONITORING BY REMOTE SENSING IN GREAT BRITAIN**

A. I. D. HORNE /In ESA EARSeL/ESA Symp. on Integrative Approaches in Remote Sensing p 99-107 Aug. 1984 refs  
 Avail: NTIS HC A17/MF A01

The use of LANDSAT imagery to supplement aerial and ground surveys of forest and woodland, hindered by weather conditions and the high skilled-labor input required, was investigated. A large island, an area of sandy heathland, and an area comprising various types of terrain (from flat coastal areas to mountain) were examined at different times of year. The LANDSAT results were compared with ground truth data from topographical maps. Results on forest cover and tree classification are encouraging, but resolution can be inadequate for detailed user requirements. Use of remote sensing data in multitemporal, multisystem and multisampling roles allows the benefits of image processing systems to be linked to digital mapping and other data bases to provide fast analysis, monitoring and output. Author (ESA)

**N85-14215#** Ludwig-Maximilians-Universitaet, Munich (West Germany). Lehrstuhl fuer Landschaftstechnik.

**INTEGRATIVE INVESTIGATION ON FOREST DAMAGE DETECTION BASED ON AIRBORNE MULTISPECTRAL SCANNER DATA**

B. KOCH and G. KRITIKOS (DFVLR, Oberpfaffenhofen, West Germany) /In ESA EARSeL/ESA Symp. on Integrative Approaches in Remote Sensing p 109-113 Aug. 1984 refs  
 Avail: NTIS HC A17/MF A01

Forest damage classification methods based on airborne scanner data, using spectral values of healthy and damaged conifers and the quantitative and qualitative influence of outside parameters on those values were examined. The test areas, selected through IR air photos, forest inventory maps and ground observations were subdivided into three damage classes and four age classes. The spectral reflectance values of the test areas were assessed from 300, 1000 and 4000 m altitude between 0.4 to 1.1 and 8 to 14 microns, and in the middle infrared at 1.6 and 2.2 microns. Results show a close correlation between reflection values and damage, age and understory vegetation.

Author (ESA)

**N85-14216#** Sveriges Lantbruksuniv., Uppsala. Dept. of Plant and Forest Protection.

**REMOTE SENSING OF PLANT STRESS AND DISEASES**

H. E. NILSSON /In ESA EARSeL/ESA Symp. on Integrative Approaches in Remote Sensing p 115-125 Aug. 1984 refs  
 Avail: NTIS HC A17/MF A01

An arrangement for hand-held radiometry (using an Exotech-100AX radiometer and an Omnidata Polycorder

datalogger) for routine studies of spectral signatures of crop plants in field plot experiments is described. It can detect previsual water stress, N-deficiency and various crop plant diseases. Detection of barley stripe disease in six-row barley and infection by *Sclerotinia sclerotiorum* in oil seed rape is illustrated. Good correlations between visual disease and stress assessment, plant growth and grain yield, and reflectance data (including change in spectral properties from one day to another) are demonstrated. Increased leaf and canopy temperatures due to infection by fungal diseases and water stress are detected by IR-thermography.

Author (ESA)

**N85-14217#** Katholieke Universiteit te Leuven (Belgium). Remote Sensing Lab.

**MULTISPECTRAL (X AND C BAND) CROP CLASSIFICATION WITH SYNTHETIC APERTURE RADAR (SAR-580) OPTICAL DATA**

R. GOMBEER /In ESA EARSeL/ESA Symp. on Integrative Approaches in Remote Sensing p 127-133 Aug. 1984 refs  
 Avail: NTIS HC A17/MF A01

Synthetic aperture radar (SAR) optical land use data were studied with a Quantimet Image Analyzer. Slope and mean density value were extracted for classification purpose from each radar band represented on film. These parameters prove to be useful for the discrimination of major crops and broader land use categories over the agricultural area studied. The classification results compares well with ground truth data collected during the SAR-aircraft overflight. Author (ESA)

**N85-14218#** Reading Univ. (England). Dept. of Geography.  
**INTEGRATION OF MULTISPECTRAL DATA OBTAINED AT DIFFERENT VIEW ANGLES FOR VEGETATION ANALYSIS**

M. J. BARNSELY /In ESA EARSeL/ESA Symp. on Integrative Approaches in Remote Sensing p 135-142 Aug. 1984 refs  
 Sponsored by UK National Environmental Research Council  
 Avail: NTIS HC A17/MF A01

The extent to which digital, multispectral imagery obtained at view angles markedly off-nadir can be validly combined with that obtained by nadir-viewing sensors to monitor vegetation was studied using aircraft data. The relationship between detected spectral response and sensor view angle is shown to depend on solar zenith angle, solar azimuth angle, and wavelength of detection. Minimum off-nadir view angle effects are found in scan directions oriented close to 90/270 deg relative to the azimuth of the Sun, and at small solar zenith angles. Maximum off-nadir view angle effects are found in scan directions oriented close to 0/180 deg relative to the azimuth of the Sun, and/or at large solar zenith angles. Integration of multispectral data obtained at different view angles is unlikely to be achieved using a single radiometric correction algorithm. Author (ESA)

**N85-14221#** Indian Inst. of Remote Sensing, Dehra Dun.  
**LANDFORM EVALUATION THROUGH INTEGRATED REMOTE SENSING METHODS. A CASE STUDY IN PARTS OF HARYANA, INDIA**

S. K. SUBRAMANIAN and D. P. RAO /In ESA EARSeL/ESA Symp. on Integrative Approaches in Remote Sensing p 161-168 Aug. 1984 refs  
 Avail: NTIS HC A17/MF A01

Integrative remote sensing techniques using aerial photographs, LANDSAT imagery and computer analysis of digital satellite data were employed to study a sample area of 5000 sq km. The area, forming a part of a semi-arid zone of Haryana State in north India, suffers from severe salinity of soils and ground water, presumably caused by water logging and impeded drainage. Results indicate that aerial photographs and LANDSAT imagery provide adequate information on genetic evolution of landforms, whereas digital processing of satellite data gives promising results for automatic classification of homogeneous units on a regional scale. Author (ESA)

## 01 AGRICULTURE AND FORESTRY

### **N85-14225#** Valencia Univ. (Spain). Dept. of Thermology. **FROST NOWCASTING IN THE AGRICULTURAL AREA OF VALENCIA (SPAIN)**

V. CASSELLES, S. GANDIA, J. MELIA, and J. DELARUBIA /in ESA EARSeL/ESA Symp. in Integrative Approaches in Remote Sensing p 201-206 Aug. 1984 refs  
Avail: NTIS HC A17/MF A01

The feasibility of using apparent temperature measurements from satellites for short term prediction of low temperatures from radiation frosts was studied. Images of the area obtained by the satellite HCMM and in situ temperature measurements were used. The temperature in the biological layer can be evaluated with 1K accuracy. Values of minimum temperature can be predicted 6 to 8 hr ahead for nights of strong radiation and mild winds or calm to the necessary accuracy for their utilization in systems of frost protection. Author (ESA)

### **N85-14237#** Technische Univ., Munich (West Germany). Inst. for General and Applied Geology. **EVALUATION OF SPOT SIMULATION DATA OF THE S GEOS CAMPAIGN OF THE EEC BY DATA OF THE TEST SITES FREIBURG AND STAUBING (WEST GERMANY)**

F. JASKOLLA /in ESA EARSeL/ESA Symp. in Integrative Approaches in Remote Sensing p 287-296 Aug. 1984 refs  
Avail: NTIS HC A17/MF A01

Using SPOT simulation data of S-GEOS Campaign of two agricultural-forestry test sites, the expected image quality improvements were investigated. Results show that spectral quality does not meet expectations. This is caused by the high correlation of band 1 (green) and band 2 (red). Real SPOT data, however, will benefit from better ground resolution and specially designed image processing techniques. Author (ESA)

### **N85-14241#** Universite Catholique de Louvain (Belgium). Lab. de Teledetection.

#### **A FIELD CONTROL METHODOLOGY OF REMOTELY SENSED DATA FOR STATISTICAL PURPOSES: AN EXAMPLE OF SPOT SIMULATED DATA IN EASTERN BELGIUM**

E. BARTHOLOME /in ESA EARSeL/ESA Symp. on Integrative Approaches in Remote Sensing p 317-323 Aug. 1984 refs  
Avail: NTIS HC A17/MF A01

The use of remotely sensed data for the generation of land use statistics, particularly agriculture, was assessed using SPOT simulation data. Field data collection and delivery of results were examined. If systematic field surveys are not made to classify the image with a good level of accuracy, it is important to realize a careful space stratification according to the variables influencing the spectral signature (altitude, exposition, climatology, soil : hydric compartment and kind of material). The classified data can be delivered as synthetic thematic maps and/or surface percentages cell by cell across a standard grid. Author (ESA)

### **N85-14243#** Reading Univ. (England). Dept. of Geography. **THE NEED FOR INTEGRATING GROUND THERMAL MEASUREMENTS WITH THERMAL AIRCRAFT IMAGERY**

D. W. LYNN /in ESA EARSeL/ESA Symp. on Integrative Approaches in Remote Sensing p 327-334 Aug. 1984 refs  
Sponsored by UK National Environment Research Council  
Avail: NTIS HC A17/MF A01

The collection, analysis and interpretation of ground thermal measurements for a variety of soils in a humid temperate climate for image acquisition scheduling and as an aid to image interpretation are outlined. Results indicate that maximum surface radiant temperatures for soils occur between 14.30 and 15.30 hr. Maximum temperatures in the upper 10 cm of soil occur 2.5 hr later. Minimum surface radiant temperatures occur before sunrise. Surface radiant temperatures of different soils are very similar during the predawn and noon periods. Author (ESA)

### **N85-14249#** Ecole Nationale Supérieure des Telecommunications, Paris (France).

#### **IMAGE TEXTURE STUDY FOR THE OPERATIONAL METEOROLOGICAL SATELLITES NOAA 6 AND NOAA 7 AND ITS VARIATION WITH TIME. APPLICATION TO THE BEAUCE REGION Ph.D. Thesis [ETUDE DE LA TEXTURE DES IMAGES DES SATELLITES METEOROLOGIQUES OPERATIONNELS NOAA 6 ET NOAA 7 ET SA VARIATION DANS LE TEMPS APPLICATION A LA BEAUCE]**

F. CHEEVASUVIT Jun. 1984 161 p refs Partly in FRENCH and ENGLISH  
(ENST-84E009; ISSN-0751-1353) Avail: NTIS HC A08/MF A01

The evolution of the thermal structure and the vegetation index along the annual cycle were investigated by NOAA satellite infrared image processing. A flat agricultural region was studied. Adaptive threshold algorithms and binary correlation were used to obtain image congruence. Stable zones were determined by models based on the inertia ellipses and the evolution of their proximity in images processed by the split and merge procedure. The evolution of the thermal averages and the average vegetation indexes were estimated for stable zones by three different methods. It is shown that image homogenous areas can be identified with known natural regions: hills, forest and the Beauce Plateau. The Beauce Plateau has a thermal structure divided into three or more areas depending on the season. Author (ESA)

### **N85-15246\*#** Utah Univ., Salt Lake City. Center for Remote Sensing and Cartography.

#### **CLASSIFICATION OF VEGETATION COMMUNITIES IN THE BATTLE MOUNTAIN SE QUADRANGLE, NEVADA WITH MSS DIGITAL DATA**

M. K. RIDD, R. D. RAMSEY, G. E. DOUGLASS, and J. A. MEROLA Dec. 1984 50 p Sponsored in part by Army Engineer Topographic Labs. Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS  
(Contract NAGW-95)

(E85-10043; NASA-CR-174220; NAS 1.26:174220; CRSC-84-7)  
Avail: NTIS HC A03/MF A01 CSCL 05B

LANDSAT MSS digital data were utilized to identify vegetation types in an area of Battle Mountain SE in northern Nevada. Ways in which terrain data may improve spectral classification were investigated. The basic data set was a CCT of LANDSAT scene 82233617450, dated 15 June 1981. Seventeen ecotypic classifications were identified in the study area on the basis of field investigations. The percent cover by life form and non-living material for the 17 classes is summarized along with the percent cover by species for the 17 classes. R.S.F.

### **N85-15248\*#** Utah Univ., Salt Lake City. Center for Remote Sensing and Cartography.

#### **AN INTEGRATED LANDSAT/ANCILLARY DATA CLASSIFICATION OF DESERT RANGELAND**

K. P. PRICE, M. K. RIDD, and J. A. MEROLA 1984 8 p  
Sponsored in part by Utah Dept. of Agriculture ERTS  
(Contract NAGW-95)

(E85-10046; NASA-CR-174222; NAS 1.26:174222) Avail: NTIS HC A02/MF A01 CSCL 08B

Range inventorying methods using LANDSAT MSS data, coupled with ancillary data were examined. The study area encompassed nearly 20,000 acres in Rush Valley, Utah. The vegetation is predominately desert shrub and annual grasses, with some annual forbs. Three LANDSAT scenes were evaluated using a Kauth-Thomas brightness/greenness data transformation (May, June, and August dates). The data was classified using a four-band maximum-likelihood classifier. A print map was taken into the field to determine the relationship between print symbols and vegetation. It was determined that classification confusion could be greatly reduced by incorporating geomorphic units and soil texture (coarse vs fine) into the classification. Spectral data, geomorphic units, and soil texture were combined in a GIS format to produce a final vegetation map identifying 12 vegetation types. Author



**N85-15251\*#** Technicolor Government Services, Inc., Moffett Field, Calif.

**MULTI CROP AREA ESTIMATION IN IDAHO USING EDITOR**

E. J. SHEFFNER Dec. 1984 37 p refs ERTS

(Contract NAS2-11101)

(E85-10054; NASA-CR-177327; NAS 1.26:177327) Avail: NTIS

HC A03/MF A01 CSCL 06C

The use of LANDSAT multispectral scanner digital data for multi-crop acreage estimation in the central Snake River Plain of Idaho was examined. Two acquisitions of LANDSAT data covering ground sample units selected from a U.S. Department of Agriculture sampling frame in a four country study site were used to train a maximum likelihood classifier which, subsequently, classified all picture elements in the study site. Acreage estimates for six major crops, by county and for the four counties combined, were generated from the classification using the Battersse-Fuller model for estimation by regression in small areas. Results from the regression analysis were compared to those obtained by direct expansion of the ground data. Using the LANDSAT data significantly decreased the errors associated with the estimates for the three largest acreage crops. The late date of the second LANDSAT acquisition may have contributed to the poor results for three summer crops.

Author

**02**

**ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES**

Includes land use analysis, urban and metroplitan studies, environmental impact, air and water pollution, geographic information systems, and geographic analysis.

**A85-10176\***

**INTERNATIONAL SYMPOSIUM ON REMOTE SENSING OF ENVIRONMENT, 17TH, UNIVERSITY OF MICHIGAN, ANN ARBOR, MI, MAY 9-13, 1983, PROCEEDINGS. VOLUMES 1, 2 & 3**

Symposium sponsored by the Environmental Research Institute of Michigan, NOAA, NASA, et al. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984. Vol. 1, 526 p.; vol. 2, 508 p.; vol. 3, 534 p. For individual items see A85-10177 to A85-10290.

The collection, processing, and analysis of remote-sensing data from ground-based, airborne, and spaceborne instruments for application to the monitoring and management of the earth and environment and resources are examined in reviews and reports, some in summary form. Subject areas covered include US policy and directions on remote sensing (RS); the future of terrestrial RS from space; RS of land, oceans, and atmosphere from a global perspective; RS in hydrological modeling; microprocessing technology; array processors; geobased information systems; artificial intelligence; the Shuttle imaging radar; and current results from Landsat-4. Among the specific topics discussed are RS application to hydrocarbon exploration, airborne gamma-radiation assessment of snow water equivalent, surface-vegetation-biomass modeling from AVHRR and Landsat data, Landsat imagery of Mediterranean pollution, fast two-dimensional filtering of thermal-scanner data, RS of severe convective storms, registration of rotated images by invariant moments, and the geometric accuracy of Landsat-4 Thematic Mapper P-tapes.

T.K.

**A85-10184\*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

**CHARACTERIZING LAND PROCESSES IN THE BIOSPHERE**

J. D. ERICKSON (NASA, Johnson Space Center, Houston, TX; NASA, Washington, DC) and A. J. TUYAHOV (NASA, Washington, DC) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 123-132. refs

NASA long-term planning for the satellite remote sensing of land areas is discussed from the perspective of a holistic interdisciplinary approach to the study of the biosphere. The earth is characterized as a biogeochemical system; the impact of human activity on this system is considered; and the primary scientific goals for their study are defined. Remote-sensing programs are seen as essential in gaining an improved understanding of energy budgets, the hydrological cycle, other biogeological cycles, and the coupling between these cycles, with the construction of a global data base and eventually the development of predictive simulation models which can be used to assess the impact of planned human activities. Current sensor development at NASA includes a multilinear array for the visible and IR and the L-band Shuttle Imaging Radar B, both to be flown on Shuttle missions in the near future; for the 1990s, a large essentially permanent man-tended interdisciplinary multisensor platform connected to an advanced data network is being planned.

T.K.

**A85-10228#**

**A STUDY ON LOCAL NATURAL ENVIRONMENT BY MULTI OBSERVATION**

K. TSUCHIYA (Chiba University, Chiba, Japan), K. KOKUBO (Higashi Matsuyama Junior High School, Matsuyama, Saitama, Japan), K. ARAI (National Space Development Agency of Japan, Tokyo, Japan), and C. ISHIDA IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 731-739. Research supported by the Toyota Foundation.

Natural environment of Hiki Hill area is studied in reference to land use and land cover map obtained from Landsat MSS data, an orographical map, and the data obtained from special dense meteorological observation networks established for this research. The analysis indicates that air temperature is always higher in urbanized areas. A high temperature area extends downstream of wind from a medium size city. Effects of land cover and land use is more pronounced in summer than in winter due to vegetation cover. On a hot summer day, rice paddies play an important role to cool the air temperature and provide a comfortable living environment. In winter, the diurnal temperature variation under a light monsoon is fairly large and influenced by land use and land cover condition.

Author

**A85-10237#**

**THERMAL I.R. FLIGHTS IN LAND USE PLANNING - SUBSURFACE CAVITIES DETECTION IN URBAN AREAS**

C. M. MARINO (Milano, Universita, Milan, Italy), G. PERNA (Bologna, Universita, Bologna, Italy), and A. M. TONELLI (Luigi Rossi A.R.C.O., Milan, Italy) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 853-862. refs

A methodology capable of evaluating the suitability of land areas for urban use is developed for the case of the municipality of Castellana Grote in southern Italy. This area has many karst cavities, which result in a subsurface hydrographic network whose potential pollution by the routine discharge of urban wastes must be assessed. Two aerial thermal IR surveys were conducted to characterize the hydrographic features in question at dawn and during full sunlight conditions.

O.C.

## 02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

**A85-10246\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

### **THE ANALYSIS OF FOREST POLICY USING LANDSAT MULTI-SPECTRAL SCANNER DATA AND GEOGRAPHIC INFORMATION SYSTEMS**

D. L. PETERSON, J. A. BRASS, S. D. NORMAN (NASA, Ames Research Center, Moffett Field, CA), and N. TOSTA-MILLER (California Department of Forestry, Sacramento, CA) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 955-964. refs

The role of Landsat multi-spectral scanner (MSS) data for forest policy analysis in the state of California has been investigated. The combined requirements for physical, socio-economic, and institutional data in policy analysis were studied to explain potential data needs. A statewide MSS data and general land cover classification was created from which country-wide data sets could be extracted for detailed analyses. The potential to combine point sample data with MSS data was examined as a means to improve specificity in estimations. MSS data was incorporated into geographic information systems to demonstrate modeling techniques using abiotic, biotic, and socio-economic data layers. The review of system configurations to help the California Department of Forestry (CDF) acquire the capability demonstrated resulted in a sequence of options for implementation. Author

**A85-10257#**

### **DETECTION OF LAND SURFACE FEATURES BY COMBINING SAR IMAGES OBSERVED FROM DIFFERENT LOOK DIRECTIONS**

H. KIMURA, T. IJIMA, A. TSUBOI, and N. KODAIRA (Remote Sensing Technology Center of Japan, Tokyo, Japan) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 1101-1108. refs

An attempt to detect land surface features by combining two Seasat images of Los Angeles observed from different look directions is discussed. A cluster analysis is applied to investigate the relation between strong radar echoes generated by city street patterns and other linear features oriented perpendicularly to the radar beam and land surface features. Two image tones from different orbits are used. The analytical method is outlined, and the processed images are shown and discussed. Land surface features corresponding to eight clusters obtained from the analysis are identified by comparison with city street maps and aerial photographs. The method is found to be an effective approach to detecting land surface features. C.D.

**A85-10261\*#** Tel-Aviv Univ. (Israel).

### **A CASE FOR GOHREM - GEOSYNCHRONOUS ORBIT HIGH RESOLUTION EARTH MONITORING**

J. OTTERMAN (Tel Aviv University, Tel Aviv, Israel), V. V. SALOMONSON, D. ATLAS, W. SHENK, M. S. MAXWELL (NASA, Goddard Space Flight Center, Greenbelt, MD), and D. E. PITTS (NASA, Johnson Space Center, Houston, TX) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 1125-1135. refs

Although the constant viewing geometry of the geostationary orbit simplifies quantitative monitoring of study areas, the high satellite altitude, in conjunction with the need for high spatial resolution, leads to large and complex sensors and spacecraft. State-of-the-art linear array detectors and a telescope of 1 m diameter and 10 m focal length can meet the requirements in question, which include a scan rate of the ground of at least 25 km/sec, the ability to cover a 150 X 150-km scene every several minutes, and an instantaneous field of view of 50 m in the visible portion of the spectrum and 1000 m in the IR. O.C.

**A85-10280\*#** Computer Sciences Corp., Greenbelt, Md.

### **A COMPARISON OF THE USEFULNESS OF CANONICAL ANALYSIS, PRINCIPAL COMPONENTS ANALYSIS, AND BAND SELECTION FOR EXTRACTION OF FEATURES FROM TMS DATA FOR LANDCOVER ANALYSIS**

R. K. BOYD (Computer Sciences Corp., Greenbelt, MD), J. O. BRUMFIELD (Marshall University, Huntington, WV), and W. J. CAMPBELL (NASA, Goddard Space Flight Center, Greenbelt, MD) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 1333-1342. refs

Three feature extraction methods, canonical analysis (CA), principal component analysis (PCA), and band selection, have been applied to Thematic Mapper Simulator (TMS) data in order to evaluate the relative performance of the methods. The results obtained show that CA is capable of providing a transformation of TMS data which leads to better classification results than provided by all seven bands, by PCA, or by band selection. A second conclusion drawn from the study is that TMS bands 2, 3, 4, and 7 (thermal) are most important for landcover classification. V.L.

**A85-10286\*#** National Aeronautics and Space Administration. National Space Technology Labs., Bay Saint Louis, Miss.

### **ANALYSIS OF LANDSAT-4 THEMATIC MAPPER DATA FOR CLASSIFICATION OF THE MOBILE, ALABAMA METROPOLITAN AREA**

D. A. QUATTROCHI (NASA, National Space Technology Laboratories, Earth Resources Laboratory, Bay Saint Louis, MS) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 1393-1402. refs

**A85-11213\*#** National Aeronautics and Space Administration. National Space Technology Labs., Bay Saint Louis, Miss.

### **ANALYSIS OF SYNTHETIC APERTURE RADAR DATA ACQUIRED OVER A VARIETY OF LAND COVER**

S.-T. WU (NASA, National Space Technology Laboratories, Bay St. Louis, MS) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-22, Nov. 1984, p. 550-557. refs

The results of Synthetic Aperture Radar (SAR) measurements over Kershaw County, South Carolina, using HH, HV, and VV polarization and two-incidence angle X-band airborne SAR system and over Baldwin County, Alabama, using HH polarization L-band Shuttle Imaging Radar (SIR-A) are presented. The X-band data indicate higher HH than VV radar return for cypress forest with standing water. Multipolarization (HH, HV, and VV) data help delineate several land-cover types that are difficult to delineate by the single polarization (HH) data. The L-band data indicate that radar return signal strength is highly correlated with tree height or age for three types of pine forest. It is found that delineation of urban/residential from deciduous forest is significantly improved by the inclusion of Landsat multispectral scanner data. Author

**A85-11587**

### **COMPLEX ANALYSIS OF THE DYNAMICS OF COMPLEX ECOSYSTEMS ON THE BASIS OF REPEATED REMOTE SENSINGS [KOMPLEKSNIY ANALIZ DINAMIKI SLOZHNYKH EKOSISTEM PO POVTORNYM DISTANTSIONNYM IZMERENIYAM]**

B. V. VINOGRADOV, U. A. SHVEDE, and A. N. KAPTSOV (Akademiya Nauk SSSR, Institut Evoliutsionnoi Morfologii i Ekologii Zhivotnykh, Moscow, USSR; Latvskii Nauchno-Issledovatel'skii Institut Zemledeliya i Ekonomiki Sel'skogo Khoziaistva, Skriveri, Latvian SSR) Akademiya Nauk SSSR, Doklady (ISSN 0002-3264), vol. 277, no. 6, 1984, p. 1505-1509. In Russian.

The technique of repeated aerial survey is examined as an effective method for the monitoring of ecosystems and the ecological prediction of their dynamics over large areas. This technique is illustrated by the aerial monitoring of a complex forest-swamp-meadow ecosystem within the middle Latvian

declivity during 1956-1974. A spatial balance model of this ecosystem constructed on the basis of the repeated sensings is presented, and a spatial-frequency matrix describing the land dynamics is given. The application of quantitative extrapolational analysis to the data obtained is considered. B.J.

### A85-12056

#### **DERIVATION OF ATMOSPHERIC CORRECTION PROCEDURES FOR LANDSAT MSS WITH PARTICULAR REFERENCE TO URBAN DATA**

B. C. FORSTER (New South Wales, University, Kensington, Australia) International Journal of Remote Sensing (ISSN 0143-1161), vol. 5, Sept.-Oct. 1984, p. 799-817. refs

The complexities and detail of urban scenes make it imperative that atmospheric effects are removed from satellite remotely sensed data prior to analysis. A study of atmospheric theory allows a simplified procedure to be developed for correction of multitemporal Landsat MSS scenes. Examples in the visible and near infrared, from a summer and winter scene, illustrate how disparate count values can be brought to good agreement as percentage reflectance. Author

### A85-12296

**MULTISPECTOR DATA ANALYSIS OF URBAN ENVIRONMENTS**  
B. N. HAACK (Ball State University, Muncie, IN) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 50, Oct. 1984, p. 1471-1477. refs

Ten data sets collected for the Los Angeles, CA basin with multispectral scanner and synthetic aperture radar sensors were spatially registered to a common map base and examined to assess their utility for urban and near-urban land-cover delineations. Training sites for eight urban land-cover types were located and statistics were obtained for the ten data files. The training site statistics were examined using transformed divergence calculations to determine intra-class variability and the best channels for classification. The study indicated that the best classification results would be obtained by selection of data from each of the available major portions of the electromagnetic spectrum. Author

### A85-12973

#### **EL CHICHON VOLCANIC ASH EFFECTS ON ATMOSPHERIC HAZE MEASURED BY NOAA7 AVHRR DATA**

A. J. RICHARDSON (U.S. Department of Agriculture, Agricultural Research Service, Weslaco, TX) Remote Sensing of Environment (ISSN 0034-4257), vol. 16, Oct. 1984, p. 157-164. refs

The monitoring of earth resources is based on an analysis of reflected and emitted radiance from the ground as received by satellite borne remote sensors. Transient atmospheric effects, such as clouds, and haze, interfere with earth resource monitoring activities by altering the detected values of reflected and emitted radiance. The present study is concerned with the effects of El Chichon volcanic ash on atmospheric haze as measured by the NOAA7 Advanced Very High Resolution Radiometer (AVHRR) data over south Texas. Experimental procedures and results are discussed. Ground-collected direct irradiance measurements and visible and infrared radiance from the NOAA7 AVHRR showed that the El Chichon volcanic eruptive products increased the atmospheric haze over south Texas. G.R.

### A85-13144#

#### **ECONOMICS OF PERMANENT POLAR PLATFORMS (PPP) FOR GLOBAL MONITORING**

D. E. KOELLE (ERNO Raumfahrttechnik GmbH, Ottobrunn, West Germany) International Astronautical Federation, International Astronautical Congress, 35th, Lausanne, Switzerland, Oct. 7-13, 1984. 8 p.  
(IAF PAPER 84-226)

Economic considerations in the development of a design for a Permanent Polar Platform (PPP) for global monitoring are discussed. Attention is given to the need for interchangeability in the design of various payload modules including: propulsion system, an auxiliary tank system, an equipment and avionics system and an orbital crew cabin. The costs of several different design

configurations are compared with total LANDSAT system costs are found to be competitive. It is shown that the overall costs of the system can be cut in half once the permanent platforms are in place. I.H.

### A85-13197#

#### **GEMS - THE GLOBAL ENVIRONMENT MONITORING SYSTEM**

H. CROZE, C. BOELCKE, and M. D. GWYNNE (United Nations, Global Environment Monitoring System, Nairobi, Kenya) International Astronautical Federation, International Astronautical Congress, 35th, Lausanne, Switzerland, Oct. 7-13, 1984. 7 p. refs  
(IAF PAPER 84-327)

The current activities of the Global Environment and Monitoring System (GEMS) of the UN Environment Program in the monitoring of pollution of air, water, soil, and food and the assessment of climate and renewable natural resources are surveyed, and the design of the planned Global Resource Information Database (GRID) is discussed. Consideration is given to the primary GRID functions within the overall GEMS mission, the GRID implementation program, initial applications of GRID, and the development of GRID hardware and software. T.K.

**A85-13198#** National Aeronautics and Space Administration, Washington, D. C.

#### **NASA CONTRIBUTIONS TO THE GLOBAL HABITABILITY PROGRAM**

D. G. MCCONNELL (NASA, Washington, DC) International Astronautical Federation, International Astronautical Congress, 35th, Lausanne, Switzerland, Oct. 7-13, 1984. 22 p.  
(IAF PAPER 84-332)

As a result of developments occurring over the last two decades, the data acquisition, storage, analysis, and transmission facilities are now available for a concerted long-term interdisciplinary and international study of the global environmental system. Such a study is the essence of the 'Global Habitability' concept introduced in 1982. The aims of Global Habitability research are considered, taking into account an understanding of the vital global processes of the earth's energy balance, the global hydrological cycle, and the biogeochemical cycling of carbon, nitrogen, phosphorus, and sulfur. Details of NASA planning for Global Habitability are discussed along with international data exchange arrangements. Attention is given to the possible contributions of satellite data and associated techniques to Global Habitability, examples of specific research conducted by NASA in support of the Global Habitability and the international sharing of data and results for Global Habitability. G.R.

### A85-13199#

#### **EUROPEAN REMOTE SENSING CONTRIBUTIONS TO GLOBAL HABITABILITY**

G. DUCHOSSOIS (ESA, Paris, France) International Astronautical Federation, International Astronautical Congress, 35th, Lausanne, Switzerland, Oct. 7-13, 1984. 3 p.  
(IAF PAPER 84-334)

The merits of space techniques to monitor global changes are reviewed. The possible European contribution to a global habitability program in the area of atmospheric, oceanic, and terrestrial processes is considered. The need for international cooperation in such a program is addressed and mechanisms already set up to promote such cooperative activity are described. C.D.

### A85-16296

#### **DETECTION OF FOREST-FIRE SMOKE PLUMES BY SATELLITE IMAGERY**

Y.-S. CHUNG and H. V. LE (Department of the Environment, Atmospheric Environment Service, Downsview, Ontario, Canada) Atmospheric Environment (ISSN 0004-6981), vol. 18, no. 10, 1984, p. 2143-2151. refs

In support of the Canadian research programmes for Long-Range Transport of Air Pollutants (LRTAP), the present study was undertaken to examine the feasibility of using satellite imagery to detect large-scale pollution episodes. Atmospheric Environment

## 02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

Service (AES) satellite imagery records were scrutinized in conjunction with meteorological and air quality data. The LRTAP from large forest fires more than 5000 km away was identified. Further evidence was obtained from analysis of digital data from NOAA satellites by employing a 'false color' technique. Computer enhanced images suggested that a smoke plume was well-defined and separated from clouds when smoke crossed over a lake and ocean. It is suggested that many large forest fires with resulting intense smoke were due to atmospheric lightning. In particular, the area influenced by the widespread smoke, from large fires in northwestern Canada on 27-28 August 1981, exceeded that area covered by dust and smoke clouds in the low-level atmosphere from the Mount St Helens volcanic eruption on 18 May 1980.

Author

**A85-16948**

**POSSIBILITIES REGARDING THE EMPLOYMENT OF SPACEBORNE SURVEYS FOR THE STUDY OF SEASONAL CHANGES REGARDING THE TERRAIN OF VARIOUS REGIONS IN THE USSR [VOZMOZHNOСТИ PRIMENENIYA KOSMICHESKOI S'EMKI DLIA IZUCHENIYA SEZONNYKH IZMENENII LANDSHAFTOV NEKOTORYKH RAIONOV SSSR]**

I. N. ELAGIN (Akademiia Nauk SSSR, Institut Lesa i Drevesing, Krasnoyarsk, USSR) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), Sept.-Oct. 1984, p. 112-114. In Russian. refs

**A85-17477\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

**UNDERSTANDING GLOBAL CHANGES ON THE LAND - A POTENTIAL FOCUS FOR NASA EARTH SCIENCES AND LAND REMOTE SENSING**

J. D. ERICKSON (NASA, Johnson Space Center, Houston, TX; NASA, Washington, DC), A. J. TUYAHOV, and H. C. HOGG (NASA, Washington, DC) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 5 p. refs

Planned NASA contributions to the study of the interaction of living organisms with their physical and chemical environments are discussed. Five major land-related research objectives are stated and the role of remote sensing in achieving them is addressed. The importance of improved sensors and cooperation with domestic and international organizations is stressed. C.D.

**A85-17525\*** Kansas Univ. Center for Research, Inc., Lawrence. **SPACEBORNE SAR DATA FOR LAND-COVER CLASSIFICATION AND CHANGE DETECTION**

B. BRISCO, F. T. ULABY, and M. C. DOBSON (University of Kansas Center for Research, Inc., Lawrence, KS) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 8 p. refs  
(Contract NAS9-15421; NCC9-7)

Supervised maximum-likelihood classifications of Seasat, SIR-A, and Landsat pixel data demonstrated that SIR-A data provided the most accurate discrimination (72 percent) between five land-cover categories. Spatial averaging of the SAR data improved classification accuracy significantly due to a reduction in both fading and within-field variability. The best multichannel classification accuracy (97.5 percent) was achieved by combining the SIR-A data with two Seasat images (ascending and descending orbits). In addition, semiquantitative analysis of Seasat-A digital data shows that orbital SAR imagery can be successfully used for multitemporal detection of change related to hydrologic and agronomic conditions by using simple machine processing techniques. Author

**A85-17551**

**LANDFORMS AND LANDUSE MAPPING OF THE RAVI RIVER BASIN USING REMOTE SENSING TECHNIQUES**

V. K. VERMA and A. KUMAR (Delhi, University, Delhi, India) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 6 p. refs

Integrated basic information on landforms and land use of the Ravi river basin embracing glacial, fluvioglacial, and fluvial environment is not adequately available on a regional scale. An attempt has been made in this communication to map the geomorphology and land use of the area, taking best advantage of repetitive coverage, terrain synoptic view, and real time analysis over the other conventional methods using standard techniques of visual interpretation of paper prints and diapositives supplemented by ground truth. Author

**A85-17582**

**SOFTWARE COMPONENTS COMMONLY USED IN GEOGRAPHIC INFORMATION SYSTEMS**

J. DANGERMOND (Environmental Systems Research Institute, Redlands, CA) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 5 p.

This paper presents an analysis of the topic, beginning with background on Automated Geographic Information Systems (AGIS's), some advantages and disadvantages of AGIS's, and a categorization of the currently available types of AGIS's. Next a series of definitions and concepts are presented to provide the terminology useful in discussing the features of AGIS's and AGIS software components. Then a series of sections follows in which the software components are described, categorized and analyzed. Techniques are described for: automation of data, processing/editing, manipulating data, data base manipulation and for graphical manipulation. The paper concludes with a list of common applications of AGIS's and these various techniques and with an indication of likely developments in this field in the near future. Author

**A85-17761**

**CHINESE SETTLEMENT PATTERN ANALYSIS USING SHUTTLE IMAGING RADAR-A DATA**

C. P. LO (Georgia, University, Athens, GA) International Journal of Remote Sensing (ISSN 0143-1161), vol. 5, Nov.-Dec. 1984, p. 959-967. refs

The Shuttle Imaging Radar-A (SIR-A) experiment was carried out during the second space flight mission of the Space Shuttle Columbia on November 12, 1981. The experiment had the objective to determine from space the radar returns of various geologic features in different regions. A side-looking synthetic aperture radar was employed to illuminate, artificially, the earth's surface with horizontally polarized microwave radiation transmitted at L-band from the orbital altitude of 259 km. There are two strips of the SIR-A data regarding North China. The present investigation is concerned with the usefulness of SIR-A data as an objective source of Chinese rural settlement distribution information which can be subjected to quadrat analysis. The mixed random-clustering process in the location of settlements is revealed by the good fit of the negative binomial distribution to the two sets of data from the Baoding and Dezhou areas of the North China Plain. G.R.

**N85-11408\*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**GEOGRAPHIC SCIENCE: EXECUTIVE SUMMARY Final Report**  
*In its The Multispectral Imaging Sci. Working Group, Vol. 2* p 105-114 7 Sep. 1982 ERTS

Avail: NTIS HC A15/MF A01 CSDL 05B

The role that TM and MSS data play in the analysis of spatial patterns for land use/land cover, geomorphology studies, and the development of cartographic products is discussed. Tables listing

geographic science data gaps, mission data requirements, and possible future remote sensing missions are included. M.A.C.

**N85-11409\*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

#### GEOGRAPHIC SCIENCE

N. BRYANT *In its* The Multispectral Imaging Sci. Working Group, Vol. 2 p 115-117 7 Sep. 1982 refs ERTS

Avail: NTIS HC A15/MF A01 CSCL 05B

The use of multispectral imaging systems in land use, geomorphological, and cartographic applications is examined. Spatial, spectral, and geometric resolution requirements for photo interpretation and multispectral pattern recognition are discussed. The potential contributions of these systems in specific experiments is also included. M.A.C.

**N85-11410\*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

#### LAND USE/LAND COVER

*In its* The Multispectral Imaging Sci. Working Group, Vol. 2 p 119-150 7 Sep. 1982 refs ERTS

Avail: NTIS HC A15/MF A01 CSCL 05B

The use of remote sensing multispectral systems in urban/suburban land use, and environmental impact from surface mines is discussed. The classification system used in conjunction with the land use/land cover data is included. M.A.C.

**N85-11436\*#** Kansas Univ., Lawrence. Space Technology Center.

#### THE APPLICATION OF REMOTE SENSING TO RESOURCE MANAGEMENT AND ENVIRONMENTAL QUALITY PROGRAMS IN KANSAS Annual Report, 1 Apr. 1982 - 31 Mar. 1983

B. G. BARR and E. A. MARTINKO, Principal Investigators Dec. 1983 209 p Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS

(Contract NGL-17-004-024)

(E85-10023; NASA-CR-174046; NAS 1.26:174046) Avail: NTIS HC A10/MF A01 CSCL 13B

The activities of the Kansas Applied Remote Sensing (KARS) Program during the period April 1, 1982 through March 31, 1983 are described. The most important work revolved around the Kansas Interagency Task Force on Applied Remote Sensing and its efforts to establish an operational service oriented remote sensing program in Kansas state government. Concomitant with this work was the upgrading of KARS capabilities to process data for state agencies through the vehicle of a low cost digital data processing system. The KARS Program continued to take an active role in irrigation mapping. KARS is now integrating data acquired through analysis of LANDSAT into geographic information systems designed for evaluating groundwater resources. KARS also continues to work at the national level on the national inventory of state natural resources information systems. R.S.F.

**N85-12292#** Ecole Nationale Supérieure des Telecommunications, Paris (France). Dept. Systemes et Communications.

#### AUTOREGRESSIVE MODELING AND THE CLASSIFICATION OF LAND CLUTTER [MODELISATION AUTOREGRESSIVE ET CLASSIFICATION DE FOUILLES DE SOLS]

J. F. AGNEL Apr. 1984 18 p refs In FRENCH Presented at Colloq. Intern. sur le Radar, Paris, 21-24 May 1984

(ENST-C-84003; ISSN-0751-1337) Avail: NTIS HC A02/MF A01

Spectral analysis of the radar signatures of three types of land was performed, based on autoregressive modeling and automatic classification. An airborne radar was used on plowed fields, forest and snow. A time sequence of 128 signatures composed a sample, and 1000 samples were recorded. A maximum entropy method was used for signal analysis. Comparison between the correlation coefficients and cepstral coefficients shows that in the latter case the recognition increases from 81% to 87.5% for all types of land and from 57% to 78% in the case of forest. Author (ESA)

**N85-14205#** Centre National de la Recherche Scientifique, Montpellier (France). Section Etude des Systemes Ecologiques.

#### INTEGRATION OF MULTIPLE THEMATIC DATA WITH LANDSAT DATA: SOME RESULTS ABOUT THE FEASIBILITY OF MEDITERRANEAN LAND COVER INVENTORIES

B. LACAZE and G. DEBUSSCHE *In* ESA EARSeL/ESA Symp. on Integrative Approaches in Remote Sensing p 31-39 Aug. 1984 refs Sponsored by CNES

Avail: NTIS HC A17/MF A01

A supervised approach to land cover identification from LANDSAT digital data based on thematic information on a Mediterranean area of Southern France was undertaken. Multitemporal vegetation index values and divergences between vegetation classes defined by physiognomical formation and/or dominant species are presented. Results indicate limitations concerning broad land-cover classes spectral separabilities, but suggest the use of LANDSAT data for identifying spatial patterns and temporal trends related to vegetation cover, when ancillary data are available. Author (ESA)

**N85-14210#** Dundee Univ. (Scotland). Lab. of Physics.

#### A COMPARISON OF TIROS-N SERIES SATELLITE DATA AND LANDSAT DATA OVER SCOTLAND

L. HAYES and A. P. CRACKNELL *In* ESA EARSeL/ESA Symp. on Integrative Approaches in Remote Sensing p 63-74 Aug. 1984 refs

Avail: NTIS HC A17/MF A01

Advanced Very High Resolution Radiometer (AVHRR/2) data from TIROS-N series polar orbiting meteorological satellites were compared with near-simultaneous LANDSAT Multi-Spectral Scanner (MSS) data in an investigation of the suitability of meteorological satellite data as a supplement to LANDSAT data for land-based applications of remote sensing. Data for Scotland are compared for 3 April 1981 and 5 November 1981. The data sets were transformed to the United Kingdom Ordnance Survey Grid System using quadratic relationships between image and map coordinates established by a modified Gauss-Newton least squares approximation. Vegetation indices calculated from the spectral responses in AVHRR/2 channels 1 and 2 and MSS bands 5 and 7 were compared. Indications are that the integration of TIROS-N series imagery, available daily, with LANDSAT imagery can lead to improved environmental monitoring, especially in regions for which regular cloud-free free LANDSAT imagery is a rarity.

Author (ESA)

**N85-14219#** Katholieke Universiteit te Leuven (Belgium). Dienst Kartografie I.A.W.

#### STATISTICS AND MAPPING OF LAND USES BY MEANS OF LANDSAT MSS IMAGERY

C. STEENMANS *In* ESA EARSeL/ESA Symp. on Integrative Approaches in Remote Sensing p 143-149 Aug. 1984 refs

Avail: NTIS HC A17/MF A01

Application of spatial remote sensing, especially computer aided thematic mapping from LANDSAT MSS imagery, as a complementary information layer to topographical mapping is discussed. The importance of correct class definition and well-founded terrain confrontation is explained by comparing different statistics on land use. The satellite data is used with other geographical data (digital or analog information). An accurate map of high quality is easily obtained even with ordinary reproduction techniques, using a quantitative generalization to improve readability, raster-vector conversions to decrease CPU-time and to make differing data compatible, and contouring algorithms to make map editing conform to commonly used thematic mapping procedures. Author (ESA)

## 02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

**N85-14220#** Southampton Univ. (England). Dept. of Geography.

### **THE USE OF THEMATIC MAPPER DATA FOR LAND COVER SURVEY**

E. J. MILTON, J. R. G. TOWNSHEND (Reading Univ., England), J. WEBB, and C. PUGH (Reading Univ., England) *In* ESA EARSeL/ESA Symp. on Integrative Approaches in Remote Sensing p 151-159 Aug. 1984 refs  
(Contract NERC/NSS-F60/B6/03; NERC/NSS-GR3/4994)  
Avail: NTIS HC A17/MF A01

Actual and simulated LANDSAT Thematic Mapper data of part of the UK were analyzed. The spatial resolving powers of the sensor are close to the predicted ones which results in the rural landscape of much of the UK being depicted in a reliable manner. The most useful bands for land cover survey are bands 2 or 3 in the visible, band 5 in the middle IR, and band 4 in the near IR. For soil survey, field measurements indicate the independent value of the slope of the reflectance curve in visible wave lengths and the relative reflectance in the middle IR. Author (ESA)

**N85-14233#** Technische Univ., Graz (Austria). Inst. for Image Processing and Computer Graphics.

### **A GEOINFORMATION EXPERT SYSTEM FOR SYNERGETIC USE OF MAP AND IMAGE DATA**

H. RANZINGER and M. RANZINGER *In* ESA EARSeL/ESA Symp. on Integrative Approaches in Remote Sensing p 263-268 Aug. 1984 refs  
Avail: NTIS HC A17/MF A01

The software modules of a geocoded data base to handle remote sensing, map, and ancillary data are described, and development of an expert system for data analysis is proposed. The system comprises the digital compilation, storing and processing of spatial Data (DESBOD), a terrain model, and an image processing system. The DESBOD subsystems include an interactive manual digitizing system, a spatial and alphanumeric data base, and an interactive data analysis and display module. Each of the system components is autonomous and can be used independently. Author (ESA)

**N85-14240#** Technische Univ., Graz (Austria).

### **COMBINATIONS OF REMOTE SENSING DATA WITH A DIGITAL MAP DATA BASE**

M. RANZINGER and H. RANZINGER *In* ESA EARSeL/ESA Symp. on Integrative Approaches in Remote Sensing p 311-316 Aug. 1984 refs  
(Contract ERO-DAJA-45-83-C-0022; ERO-DAJA-45-84-C-0011)  
Avail: NTIS HC A17/MF A01

The capabilities of a geoinformation system which handles digital image data, spatial data derived from maps, and digital terrain models are illustrated by a case study. The suitability for recreation facility planning is evaluated using a model with different kinds of thematic data including multitemporal LANDSAT MSS images, a digital terrain model, a map showing pollution stress zones, and a map of administrative boundaries. Computations carried out on raster data are integrated into the geoinformation data base. Author (ESA)

### **N85-14245# Exmoor National Park Dept., Dulverton (England). INVENTORY AND MONITORING OF NATIONAL PARK LANDSCAPES**

L. F. CURTIS *In* ESA EARSeL/ESA Symp. on Integrative Approaches in Remote Sensing p 349-352 Aug. 1984 refs  
Avail: NTIS HC A17/MF A01

Inventory and monitoring of National Park landscapes was carried out by ground surveys and remote sensing, particularly aerial survey and satellite data analysis. Examples of aerial survey, satellite data analysis and SAR 580 experiments for landscape management in a National Park are discussed. Recommendations for integration of support services to assist operational use of remote sensing data are made. Author (ESA)

**N85-15249\*#** Utah Univ., Salt Lake City. Center for Remote Sensing and Cartography.

### **A GEOGRAPHIC INFORMATION SYSTEM FOR RESOURCE MANAGERS BASED ON MULTI-LEVEL REMOTE SENSING DATA**

D. J. WHEELER and M. K. RIDD 1984 10 p Sponsored in part by Utah Dept. of Agriculture ERTS  
(Contract NAGW-95)  
(E85-10047; NASA-CR-174223; NAS 1.26:174223) Avail: NTIS HC A02/MF A01 CSCL 05B

Procedures followed in developing a test case geographic information system derived primarily from remotely sensed data for the North Cache Soil Conservation District (SCD) in northern Utah are outlined. The North Cache SCD faces serious problems regarding water allocation, flood and geologic hazards, urban encroachment into prime farmland, soil erosion, and wildlife habitat. Four fundamental data planes were initially entered into the geo-referenced data base: (1) land use/land cover information for the agricultural and built-up areas of the valley obtained from various forms of aerial photography; (2) vegetation/land cover in mountains classified digitally from LANDSAT; (3) geomorphic terrain units derived from aerial photography and soil maps; and (4) digital terrain maps obtained from DMA digital data. The land use/vegetation/land cover information from manual photographic and LANDSAT interpretation were joined digitally into a single data plane with an integrated legend, and segmented into quadrangle units. These were merged with the digitized geomorphic units and the digital terrain data using a Prime 400 minicomputer. All data planes were geo-referenced to a UTM coordinate grid. Author

## 03

## GEODESY AND CARTOGRAPHY

Includes mapping and topography.

**A85-10211\*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

### **EXTRACTION OF TOPOGRAPHY FROM SIDE-LOOKING SATELLITE SYSTEMS A CASE STUDY WITH SPOT SIMULATION DATA**

S. G. UNGAR (NASA, Goddard Space Flight Center, Greenbelt, MD), R. IRISH, A. H. STRAHLER (Hunter College, New York, NY), C. J. MERRY, H. L. MCKIM (U.S. Army, Cold Regions Research and Engineering Laboratory, Hanover, NH), B. GAUTHIER (Centre National d'Etudes Spatiales, Paris, France), G. WEILL (SPOT Image Corp., Washington, DC), and M. S. MILLER (M/A-COM Sigma Data, Inc., New York, NY) *In*: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 535-550. Army-sponsored research.

Techniques for reconstructing topographic data from side-looking satellite systems have been developed whereby nadir and off-nadir passes are coaligned to calculate the stereo displacement for each pixel in the nadir view by correlating a small subarea to a corresponding subarea in the off-nadir pass. The correlation algorithm was tested on two pairs of data sets consisting of patterns of bars and boxes and then applied to the SPOT simulation data set. The correlation was a maximum in areas where the relief was changing gradually, while in areas of constantly changing topography, the correlation decreased. V.L.

A85-13267#

**UTILIZATION OF SATELLITE LASER RANGING DATA IN SATELLITE GEODESY**

A. G. MASEVICH and S. K. TATEVIAN (Akademii Nauk SSSR, Astronomicheskii Sovet, Moscow, USSR) International Astronautical Federation, International Astronautical Congress, 35th, Lausanne, Switzerland, Oct. 7-13, 1984. 5 p. refs (IAF PAPER 84-422)

The utilization of satellite laser ranging data in satellite geodesy is discussed with reference to results obtained by a network of laser tracking stations set up under the Intercomos program. Long-term predictions of satellite orbital elements and positioning of ground-based stations, determination of polar motion, and Universal time corrections are made using the Prognost routine. Particular attention is given to the application of laser ranging data for determination of the position of satellites during the performance of on-board scientific experiments. As an example, results of laser and photographic observations of the satellite Intercomos Bulgaria-1300 are presented. V.L.

A85-13943#

**SEASAT ALTIMETRY, THE NORTH ATLANTIC GEOID, AND EVALUATION BY SHIPBORNE SUBSATELLITE PROFILES**

P. R. VOGT, N. Z. CHERKIS (U.S. Navy, Naval Research Laboratory, Washington, DC), B. ZONDEK (U.S. Navy, Naval Surface Weapons Center, Dahlgren, VA), P. W. FELL (U.S. Defense Mapping Agency, Hydrographic/Topographic Center, Washington, DC; U.S. Navy, Naval Surface Weapons Center, Dahlgren, VA), and R. K. PERRY (Williams and Heintz Map Corp., Capitol Heights, MD; U.S. Navy, Naval Research Laboratory, Washington, DC) Journal of Geophysical Research (ISSN 0148-0227), vol. 89, Nov. 10, 1984, p. 9885-9903. Navy-supported research. refs

A geological evaluation of geoid anomalies over the North Atlantic is presented with emphasis on short wavelength undulations mapped by Seasat radar altimetry. A forward modelling technique to compute both gravity and vertical deflection from crustal structure as defined by seismic reflection data is presented. The intermediate-wavelength geoid correlates with plate age over Cenozoic crust, and major fracture zones (FZs) appear as geoid steps. A 3.5 to 5 m high over the Bermuda Rise may reflect thermal rejuvenation created within the plate 40-50 Ma. The vertical deflection computed from the Seasat geoid compares well with one based on seismic reflection. Except near seamounts, the principal contributor to geoid anomalies is fracture zone topography. All major and many minor FZs appear as geoid lineations. Some geoid lineations are oblique to both isochron and FZ trends; east of the Puerto Rico Trench such anomalies may reflect compressional deformation within Atlantic lithosphere. C.D.

A85-16883

**GEODETIC APPLICATION OF ALTIMETER OBSERVATIONS [GEODAETISCHE NUTZUNG VON ALTIMETERBEOBACHTUNGEN]**

W. BOSCH (Deutsches Geodaetisches Forschungsinstitut, Munich, West Germany) Zeitschrift fuer Flugwissenschaften und Weltraumforschung (ISSN 0342-068X), vol. 8, Sept.-Oct. 1984, p. 298-304. In German. refs

The study of the long-wave characteristics and fine structure of the earth's gravitational field using altimetry from the satellites Geos-3 and Seasat is discussed. The importance of an altimetrically determined sea surface topography is emphasized. Some practical applications of these geodetic findings are described along with their implications for problems in geophysical, geological, and oceanographic problems. Future tasks for satellite altimeter missions are addressed. C.D.

A85-16893

**LAND USE CARTOGRAPHY FROM LANDSAT DATA USING THE NEUMUENSTER SHEET CC 2318 OF THE TOPOGRAPHIC SURVEY MAP 1:200,000 AS AN EXAMPLE [LANDNUTZUNGSKARTIERUNG AUS LANDSAT-DATEN AM BEISPIEL DES BLATTES CC 2318 NEUMUENSTER DER TOPOGRAPHISCHEN UEBERSICHTSKARTE 1:200,000]**

W. HASSENPFUG (Kiel, Paedagogische Hochschule, Kiel, West Germany) Zeitschrift fuer Flugwissenschaften und Weltraumforschung (ISSN 0342-068X), vol. 8, Sept.-Oct. 1984, p. 352-355. In German.

A85-18453\*

Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**SENSITIVITY OF THERMAL INERTIA CALCULATIONS TO VARIATIONS IN ENVIRONMENTAL FACTORS**

A. B. KAHLE, R. E. ALLEY (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA), and J. P. SCHIOLDGE (California Institute of Technology, Jet Propulsion Laboratory, Pasadena; Arete Associates, Inc., Encino, CA) Remote Sensing of Environment (ISSN 0034-4257), vol. 16, Dec. 1984, p. 211-232. NASA-supported research. refs

The sensitivity of thermal inertia (TI) calculations to errors in the measurement or parameterization of a number of environmental factors is considered here. The factors include effects of radiative transfer in the atmosphere, surface albedo and emissivity, variations in surface turbulent heat flux density, cloud cover, vegetative cover, and topography. The error analysis is based upon data from the Heat Capacity Mapping Mission (HCMM) satellite for July 1978 at three separate test sites in the deserts of the western United States. Results show that typical errors in atmospheric radiative transfer, cloud cover, and vegetative cover can individually cause root-mean-square (RMS) errors of about 10 percent (with atmospheric effects sometimes as large as 30-40 percent) in HCMM-derived thermal inertia images of 20,000-200,000 pixels.

Author

N85-10030# Air Force Geophysics Lab., Hanscom AFB, Mass.

**GLOBAL POSITIONING SYSTEM: GEODETIC APPLICATIONS**

D. H. ECKHARDT 15 Aug. 1984 8 p Presented at the Intern. Symp., Point Positioning in Marine Geodesy, Maracaibo, 23-27 Feb. 1983

(Contract AF PROJ. 2309)

(AD-A144904; AFGL-TR-84-0209) Avail: NTIS HC A02/MF A01 CSCL 08E

The NAVSTAR Global Positioning System (GPS) is a joint service spacebased radio navigation network of the U.S. Department of Defense with the Air Force as the executive service. The system will be fully operational in the late 1980's GPS and will provide accurate time and three dimensional position and velocity information to users anywhere in the world, including those in near-earth orbits. The (real-time) navigation position determinations will be based on satellite-to-user transit times of modulated microwave signals broadcast by the GPS satellites. For navigation, the capability for absolute positioning on the order of 200 m or better will be made available for general civil use. The highest accuracy three dimensional navigation capability, on the order of 16 m, will be made available to U.S. Government agencies and to qualified U.S. commercial users where proper security measures can be established. Even higher accuracy relative geodetic positioning capability, on the order of 1 to 10 cm (depending on the baseline lengths), will be attainable by radio interferometric (differential phase) techniques which will be available for general civil use. Achieving these high geodetic accuracies requires continuous simultaneous observations for up to two or three hours at each survey site. Accurate relative (non real-time) navigation positions and velocities, using Doppler and integrated Doppler techniques, will also be feasible for general civil use. GRA



### 03 GEODESY AND CARTOGRAPHY

**N85-10478#** National Geodetic Survey, Rockville, Md.  
**PREDICTION OF DEFLECTIONS OF THE VERTICAL BY GRAVIMETRIC METHODS**  
R. J. FURY. 1984. 34 p refs  
(PB84-213727; NOAA-TR-NOS-NGS-28; NOAA-84062602) Avail: NTIS HC A03/MF A01 CSCL 08E

Since an abundance of gravity data has become available for the prediction of vertical deflections and geoid undulations to sufficient accuracy, a gravimetric method was developed for predicting these geodetic parameters. This system employs numerical integration of surface gravity in the vicinity of the station and harmonic coefficients of a geoid derived from satellite tracking data in distant areas. The technique was successfully used for the prediction of vertical deflections and geoid undulation at every occupied station of the U.S. horizontal geodetic network. Systematic errors were removed by fitting the predictions to deflections obtained by astronomic methods. GRA

**N85-11412\*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.  
**CARTOGRAPHY Final Report**  
*In its* The Multispectral Imaging Sci. Working Group, Vol. 2 p 181-206 7 Sep. 1982 refs ERTS  
Avail: NTIS HC A15/MF A01 CSCL 05B

The demand for cartographic products at scales of 1:25,000 to 1:250,000 continues to increase throughout the world in order to meet requirements associated with: the survey and management of natural resources; environmental planning; and the establishment of geo-referenced data bases. A satellite system involving the use of multispectral linear array (MLA) sensors designed to meet cartographic requirements in terms of the completeness of detail and geometric accuracy standards associated with mapping programs offers great promise for rapidly providing the data with which to produce four types of map products/and data. These include topographic maps; digital terrain information (x,y,z coordinates; thematic mapping; and image maps. Each type of cartographic product/data is briefly considered in relation to current needs. B.G.

**N85-11433\*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.  
**ON GRAVITY FROM SST, GEOID FROM SEASAT, AND PLATE AGE AND FRACTURE ZONES IN THE PACIFIC**  
B. D. MARSH (Johns Hopkins Univ., Baltimore), J. G. MARSH, and R. G. WILLIAMSON, Principal Investigators (EG and G Washington Analytical Services Center, Inc., Riverdale, Md.) 1984 39 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS  
(Contract NAG5-32)  
(E85-10020; NASA-TM-87387; NAS 1.15:87387) Avail: NTIS HC A03/MF A01 CSCL 08E

A composite map produced by combining 90 passes of SST data show good agreement with conventional GEM models. The SEASAT altimeter data were deduced and found to agree with both the SST and GEM fields. The maps are dominated (especially in the east) by a pattern of roughly east-west anomalies with a transverse wavelength of about 2000 km. Comparison with regional bathymetric data shows a remarkably close correlation with plate age. Most anomalies in the east half of the Pacific could be partly caused by regional differences in plate age. The amplitude of these geoid or gravity anomalies caused by age differences should decrease with absolute plate age, and large anomalies (approximately 3 m) over old, smooth sea floor may indicate a further deeper source within or perhaps below the lithosphere. The possible plume size and ascent velocity necessary to supply deep mantle material to the upper mantle without complete thermal equilibration was considered. A plume emanating from a buoyant layer 100 km thick and 10,000 times less viscous than the surrounding mantle should have a diameter of about 400 km and must ascend at about 10 cm/yr to arrive still anomalously hot in the uppermost mantle. A.R.H.

**N85-11490\*#** Ohio State Univ., Columbus. Dept. of Geodetic Science and Surveying.  
**BASIC RESEARCH FOR THE GEODYNAMICS PROGRAM Semiannual Status Report, Apr. - Sep. 1984**  
Oct. 1984 35 p refs  
(Contract NSG-5265)  
(NASA-CR-174055; NAS 1.26:174055; SASR-13) Avail: NTIS HC A03/MF A01 CSCL 08G

Some objectives of this geodynamic program are: (1) optimal utilization of laser and VLBI observations as reference frames for geodynamics, (2) utilization of range difference observations in geodynamics, and (3) estimation techniques in crustal deformation analysis. The determination of Earth rotation parameters from different space geodetic systems is studied. Also reported on is the utilization of simultaneous laser range differences for the determination of baseline variation. An algorithm for the analysis of regional or local crustal deformation measurements is proposed along with other techniques and testing procedures. Some results of the reference from comparisons in terms of the pole coordinates from different techniques are presented. E.R.

**N85-12413\*#** Miami Univ., Fla. School of Marine and Atmospheric Science.  
**CONTINENTAL AND OCEANIC CRUSTAL MAGNETIZATION MODELLING Semiannual Status Report**  
C. G. A. HARRISON and K. L. HAYLING 1984 11 p refs ERTS  
(Contract NAG5-414)  
(E85-10034; NASA-CR-174125; NAS 1.26:174125) Avail: NTIS HC A02/MF A01 CSCL 08C

Inversion of magnetic data from the MAGSAT satellite, to arrive at intensities of magnetization of the Earth's crust, was performed by two different methods. The first method uses a spherical harmonic model of the magnetic field. The coefficients believed to represent sources in the Earth's crust can then be inverted to arrive at vertical dipole moments per unit area at the Earth's surface. The spherical harmonic models contain coefficients of degrees of harmonics up to 23. The dipole moment per unit area for a surface element can then be determined by summing the contribution for each individual degree of harmonic. The magnetic moments were calculated for continental and oceanic areas separately as well as over certain latitudinal segments. Of primary concern was to determine whether there are any differences between continental and oceanic areas. The second analysis with magnetization intensities was made using narrower ranges of degrees of harmonics, assuming that higher degrees are present in the core field signal. M.G.

**N85-12414\*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).  
**SPECIFICATION AND PRELIMINARY DESIGN OF THE CARTA SYSTEM FOR SATELLITE CARTOGRAPHY [ESPECIFICACAO E PROJETO PRELIMINAR DO SISTEMA CARTA PARA CARTOGRAFIA POR SATELITE]**  
A. J. F. MACHADOESILVA, Principal Investigator, F. A. M. II, G. C. NETO, P. R. M. SERRA, and R. C. M. SOUZA Aug. 1984 52 p refs In PORTUGUESE; ENGLISH summary Presented at the 36th Reuniao Anual da SBPC, Sao Paulo, 4-11 Jul. 1984 Sponsored by NASA  
(E85-10035; NASA-CR-174126; NAS 1.26:174126; INPE-3256-PRE/593) Avail: NTIS HC A04/MF A01 CSCL 08F

Digital imagery acquired by satellite have inherent geometrical distortion due to sensor characteristics and to platform variations. In INPE a software system for geometric correction of LANDSAT MSS imagery is under development. Such connected imagery will be useful for map generation. Important examples are the generation of LANDSAT image-charts for the Amazon region and the possibility of integrating digital satellite imagery into a Geographic Information System. R.S.F.



**N85-12418#** Maine Univ., Orono.

**USE AND VALUE OF A GEODETIC REFERENCE SYSTEM**

E. F. EPSTEIN and T. D. DUCHESNEAU Apr. 1984 45 p  
refs

(Contract NA82AA-D-00016)

(PB84-216167; NOAA-84070907; LC-84-10169) Avail: NTIS HC  
A03/MF A01 CSCL 13B

A benefit cost framework is applied to the issue of identifying and assessing economic value arising from utilization of a geodetic reference system. The findings indicate that investment in utilization of a geodetic reference system yields a large stream of benefits to an agency or jurisdiction that typically requires accurate, compatible, spatial information for decision-making. The major portion of benefits occurs with the use of spatial information based on a geodetic system by secondary and tertiary users. In the context of economic value, a geodetic reference system can be viewed as an input to a production process. The outputs of this process are spatial information products with the attribute of universal compatibility. Universal compatibility allows users of the information products to combine or integrate across information products independently of the original purpose for which the information was produced. GRA

**N85-13365\*#** Johns Hopkins Univ., Baltimore, Md. Dept. of Earth and Planetary Sciences.

**LITHOSPHERIC STRUCTURE IN THE PACIFIC GEOID Semiannual Report**

B. D. MARSH 14 Dec. 1984 5 p

(Contract NAG5-32)

(NASA-CR-174155; NAS 1.26:174155) Avail: NTIS HC A02/MF  
A01 CSCL 08E

In order that sub-lithospheric density variations be revealed with the geoid, the regional geoid anomalies associated with bathymetric variations must first be removed. Spectral techniques were used to generate a synthetic geoid by filtering the residual bathymetry assuming an Airy-type isostatic compensation model. An unbiased estimated of the admittances show that for region under study, no single compensation mechanism will explain all of the power in the geoid. Nevertheless, because topographic features are mainly coherent with the geoid, to first order an isostatically compensated lithosphere cut by major E-W fracture zones accounts for most of the power in the high degree and other SEASAT geoid in the Pacific. B.G.

**N85-13831#** Centre National d'Etudes Spatiales, Toulouse (France). Dept. DTI/MS/CD.

**THE MOTION OF THE EARTH BY DOPPLER OBSERVING CAMPAIGN (MEDOC) (EXPERIENCE MEDOC)**

Y. LABRUNE *In its Satellite Motion: Lectures and Exercises on Space Mech.* p 783-809 1984 refs In FRENCH

Avail: NTIS HC A99/MF A01

The Motion of the Earth by Doppler Observing Campaign (MEDOC) 2, experiment organization, data acquisition, and data processing algorithms are described. The MEDOC 2 experiment uses TRANSIT satellites to create a worldwide coordinate reference system, and to calculate the movement of the Earth's axis of rotation to within 20 cm per day. The data collected will also be used in estimating point positions with 50 cm absolute accuracy, or 20 cm relative accuracy. Polar wandering can be measured to within 15 cm. Author (ESA)

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### GEOLOGY AND MINERAL RESOURCES

Includes mineral deposits, petroleum deposits, spectral properties of rocks, geological exploration, and lithology.

**A85-10191#**

**OVERVIEW OF A GEOCHEMICAL DATA ANALYSIS SYSTEM DESIGN FOR THE STATE OF ALASKA TO BE INCLUDED IN THE PROCEEDINGS OF SYMPOSIA ON REMOTE SENSING OF ENVIRONMENT**

N. L. FAUST, W. M. FINLAY (Georgia Institute of Technology, Atlanta, GA), and L. E. JORDAN, III (ERDAS, Inc., Atlanta, GA) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 247-253.

A multiuser computer analysis system has been developed in order to provide map information in Alaska's mineral resources. The system is principally designed to catalog and analyze geochemical data gathered by the U.S. Department of Energy, as well as to sample data gathered by field geochemists from the Alaska Department of Natural Resources. Concentrations are given for more than 50 chemical elements. Once the chemical concentration surface for a given element is generated, it may be combined with geophysical data and Landsat digital data for the same area in order to produce a multilayered geographic data base. O.C.

**A85-10197#**

**REMOTE SENSING APPLICATION IN STRUCTURAL EVALUATION FOR HYDROCARBON EXPLORATION OF WEST RAJASTHAN SHELF, INDIA - AN INTEGRATED CASE STUDY**

B. M. KHAR (Oil and Natural Gas Commission, Dehra Dun, India) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 357-367. refs

**A85-10225#**

**STRUCTURAL MAPPING OF PRECAMBRIAN ROCKS BELOW PALEOZOIC AND QUATERNARY SEDIMENTARY MATERIAL USING SPECTRAL AND GEOPHYSICAL REMOTE SENSING TECHNIQUES IN THE CANADIAN SHIELD**

D. T. ANDERSON and K. S. MISRA (Manitoba, University, Winnipeg, Canada) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 697-701.

**A85-10226#**

**REGIONAL GEOLOGICAL INVESTIGATION OF WADI EL ALLAQI AREA, SOUTHERN EGYPT, FROM THE INTERPRETATION OF LANDSAT IMAGERY**

E. M. EL SHAZLY, M. A. ABDEL HADY, and I. A. EL KASSAS (Nuclear Materials Corp., Remote Sensing Center, Cairo, Egypt) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 703-713.

A Landsat-2 scene of the Wadi El Allaqi area in southern Egypt is the basis of the present investigation of geology, structure, lithology and drainage, as well as environmental conditions. Structural lineaments, together with geological and lithological conditions, determine drainage patterns for the area in question. The most important environmental change noted in the configuration of the Aswan High Dam Reservoir emerged through a comparison of the image presently interpreted, which is dated December 30, 1981, with previously interpreted Landsat-1 and -2 images from 1972, 1973, 1975, and 1977. All these images were

## 04 GEOLOGY AND MINERAL RESOURCES

in turn compared with a 1944 map compiled prior to the High Dam's construction. O.C.

**A85-10227#**

### **NEW BEDFORD QUADRANGLE, MASSACHUSETTS - A PROTOTYPE 1:100,000-SCALE LANDSAT 3 RETURN BEAM VIDICON (RBV) IMAGE MAP**

R. S. WILLIAMS, JR., N. L. FALCONE, R. A. BARLOW, and K. FITZPATRICK-LINS (U.S. Geological Survey, Reston, VA) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 715-729. refs

One objective of the Landsat research conducted within the U.S. Geological Survey (USGS) has been the preparation of experimental image map products. Although much of the emphasis has been on the Landsat multispectral scanner (MSS) image, analytical work by the National Mapping Division established that return beam vidicon (RBV) images could be used to produce planimetrically accurate 1:250,000-scale image maps. The work also suggested that geometrically acceptable image maps at 1:100,000-scale might be possible. To support a geologic mapping project, a 1:100,000-scale image map of Cape Cod, Massachusetts, and environs was prepared from parts of four Landsat 3 RBV images (30167-14444-A, B, C, and D; 19 August 1978). The mosaic had an overall root mean square error (RMSE) of 50 m, as compared to a maximum RMSE of 33 m, which is equivalent to U.S. National Map Accuracy Standards (NMAS) for 1:100,000-scale map products. Using the planned 1:100,000-scale topographic line map as a format, the USGS published (1983) a prototype 1:100,000-scale RBV image map of the New Bedford quadrangle, Massachusetts. Author

**A85-10265#**

### **SEASAT-A DETECTION OF GEOMORPHOLOGIC PHENOMENA IN THE SAINT-LAWRENCE VALLEY, QUEBEC**

A. LAROCQUE, G. LAROCQUE, P. DESFOSES, and G. H. J. GWYN (Sherbrooke, Universite, Sherbrooke, Quebec, Canada) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 1179-1186. refs

**A85-11208\*** Technicolor Government Services, Inc., Moffett Field, Calif.

### **STATISTICAL ANALYSIS OF THEMATIC MAPPER SIMULATOR DATA FOR THE GEOBOTANICAL DISCRIMINATION OF ROCK TYPES IN SOUTHWEST OREGON**

L. A. MORRISSEY, K. J. WEINSTOCK (Technicolor Government Services, Inc., Moffett Field, CA), D. A. MOUAT (Stanford University, Stanford, CA), and D. H. CARD (NASA, Ames Research Center, Moffett Field, CA) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-22, Nov. 1984, p. 525-530. refs

An evaluation of Thematic Mapper Simulator (TMS) data for the geobotanical discrimination of rock types based on vegetative cover characteristics is addressed in this research. A methodology for accomplishing this evaluation utilizing univariate and multivariate techniques is presented. TMS data acquired with a Daedalus DEI-1260 multispectral scanner were integrated with vegetation and geologic information for subsequent statistical analyses, which included a chi-square test, an analysis of variance, stepwise discriminant analysis, and Duncan's multiple range test. Results indicate that ultramafic rock types are spectrally separable from nonultramafics based on vegetative cover through the use of statistical analyses. Author

**A85-11503\*** Smithsonian Institution, Washington, D. C.

### **THERMAL INFRARED SATELLITE DATA FOR THE STUDY OF TECTONIC FEATURES**

C. G. ANDRE (Smithsonian Institution, Washington, DC) and H. W. BLODGET (NASA, Goddard Space Flight Center, Geophysics Branch, Greenbelt, MD) Geophysical Research Letters (ISSN 0094-8276), vol. 11, Oct. 1984, p. 983-986. refs (Contract NAS5-28095)

Multispectral thermal infrared data from the NOAA-7 Advanced Very High Resolution Radiometer (AVHRR) have been processed to evaluate their potential for mapping tectonic features. Day/night ratio data from 3 thermal bands between 3.7 and 12.0 microns were used to construct a thermal infrared color image that emphasizes heat retention differences in surface materials as a function of wavelength. The study area is an arid region of the Arabian Peninsula where lithologic units are widely exposed to satellite detectors. In spite of the coarse resolution of 1.1 km at nadir, the image of emitted radiation data contains prominent features that appear to relate to fault systems, unmapped extensions of fault systems, and drainage patterns that are lacking in AVHRR reflected radiation data. Author

**A85-11885\***

Jet Propulsion Lab., California Inst. of Tech., Pasadena.

### **GRANITIC TERRAINS VIEWED REMOTELY BY SHUTTLE INFRARED RADIOMETRY - SOME COMPOSITIONAL PREDICTIONS**

A. K. BAIRD (California Institute of Technology, Jet Propulsion Laboratory, Pasadena; Pomona College, Claremont, CA) Journal of Geophysical Research (ISSN 0148-0227), vol. 89, Oct. 10, 1984, p. 9439-9447. NASA-supported research. refs

Ratios of intensities of near-infrared spectral bands, measured in reflectance, quantitatively predict the iron content of granitic rocks. Such data from the 1.60- and 1.05-micron bands of the Shuttle multispectral infrared radiometer have been used to study granitic rocks along orbits crossing Baja California, Mexico, and the Eastern Desert of Egypt. Both regions are arid and relatively to essentially free of vegetation, and there is no indication in the spectra that surface chemical alteration masks the true composition of the unweathered rock. Predicted values of iron are consistent with known compositional types of most of the rocks along the orbital paths. Results demonstrate that the near-infrared method used is a powerful technique to average the variability of these rocks on the scales of meters to kilometers. Author

**A85-12006\*** National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

### **PETROLOGIC MODEL OF THE NORTHERN MISSISSIPPI EMBAYMENT BASED ON SATELLITE MAGNETIC AND GROUND-BASED GEOPHYSICAL DATA**

H. H. THOMAS (NASA, Goddard Space Flight Center, Geophysics Branch, Greenbelt, MD) Earth and Planetary Science Letters (ISSN 0012-821X), vol. 70, no. 1, Sept. 1984, p. 115-120. refs

A petrologic model of the northern Mississippi Embayment, derived from gravity, seismic and rift data, is evaluated by converting the model to a magnetization model which is compared with satellite magnetic anomaly models. A magnetization contrast of approximately -0.54 A/m, determined from the petrologic model of the embayment compares favorably to values of -0.62 A/m and -0.45 A/m from a Magsat United States Apparent Magnetization Contrast Map and a published POGO magnetization contrast model, respectively. The petrologic model suggests that the magnetic anomaly low associated with the Mississippi Embayment may be largely due to the intrusion under non-oxidizing conditions of low Curie temperature gabbroic material at the base of the crust of the embayment. Near-surface mafic plutons, bordering the Mississippi Valley Graben, appear from aeromagnetic data to have higher magnetizations than the deeper gabbroic material; however, it is impossible to ascertain if this is due to compositional differences or similar material at shallower (lower temperature) depths. These results indicate that variations in the Curie temperatures of intrusions accompanying rifting may account

for a large part of the wide range of magnetic anomalies associated with presently inactive rifts with normal heat flow. Author

#### A85-12008

##### DELINEATION OF CANADIAN SEDIMENTARY BASINS FROM MAGSAT DATA

J. ARKANI-HAMED, W. E. S. URQUHART, and D. W. STRANGWAY (Toronto, University, Toronto, Canada) *Earth and Planetary Science Letters* (ISSN 0012-821X), vol. 70, no. 1, Sept. 1984, p. 148-156. Research supported by the Natural Sciences and Engineering Research Council of Canada. refs

A crustal scalar magnetic anomaly map of Canada and the northern United States is derived using data collected from the Magsat satellite. The anomalies are correlated to geological features. Basins associated with failed arms of old rifts have high magnetic anomalies. The Rocky Mountains, the Appalachian Mountains, the suture zone of the Grenville province, modern hotspots and ocean ridges have low magnetic anomalies.

Author

#### A85-12162\* Kansas Univ., Lawrence.

##### OPTIMIZING SPACE RADARS FOR GEOLOGICAL ANALYSIS IN TROPICAL ENVIRONMENTS

L. F. DELLWIG and J. D. CURLIS (Kansas, University, Lawrence, KS) *Modern Geology* (ISSN 0026-7775), vol. 8, no. 4, 1984, p. 217-225. Research supported by the Phillips Petroleum Co. refs (Contract JPL-954946; NASA TASK RD-185)

A swath along the Motagua Fault in northeastern Guatemala was imaged with the AN/APS-94D airborne and the SIR-A Space Shuttle-borne radars with a difference in look direction on the order of ten degrees. Imagery of the Panama Canal Zone, overlapping in coverage but with diverse look directions was produced by the AN/APQ-97 and GEMS airborne radars and SIR-A. Taking into account the diversity of system and operational parameters, comparative analysis of the images well documented that the increased data content of the airborne radar imagery was due to the high look angles at which these systems operate.

Author

#### A85-12164

##### SPECTRAL SIGNATURES (VISIBLE/NEAR INFRARED) OF ROCKS AND ORES - APPLICATION TO REMOTE SENSING OF THREE TYPES OF OREBODIES FROM S. MOROCCO

A. BOTHOREL (Cisi Petrole Services, Rueil-Malmaison, Hauts-de-Seine; Paris VI, Universite, Paris, France), B. CERVILLE, J. CHOROWICZ, G. TAMAIN (Paris VI, Universite, Paris, France), and EL MEHDI ALEM (Institut Scientifique, Rabat, Morocco) *Modern Geology* (ISSN 0026-7775), vol. 8, no. 4, 1984, p. 277-294. refs

Lab spectrophotometry was performed to acquire visible and NIR diffuse reflectance spectra for powders and for naturally outcropping rocks, both mineralized and sterile. Spectroradiometric field measurements on the mineralized zones from which the rocks were sampled confirmed the validity of lab calibrations based on the outcropping surface of the rocks. The application of these results to three arid mineralized regions in S. Morocco has given information which is dependent on the type of orebody. For an iron sulfide bearing deposit, oxidized at the surface into an iron cap, the conditions are favorable for remote sensing from satellite. For a cobalt-nickel bearing mineralization, linked with a serpentized ophiolite, only the serpentinites could be remotely detected and mapped. For interstratified copper impregnations within red sandstones, the narrowness of the visible absorption band characteristic of malachite should cause difficulties for remote detection with actual satellite sensors.

Author

#### A85-12295

##### THE SIDE-LOOKING AIRBORNE RADAR PROGRAM OF THE U.S. GEOLOGICAL SURVEY

C. S. SOUTHWORTH (U.S. Geological Survey, Reston, VA) *Photogrammetric Engineering and Remote Sensing* (ISSN 0099-1112), vol. 50, Oct. 1984, p. 1467-1470.

A table describing past and planned acquisition of SLAR data by the U.S. Geological Survey is presented, and examples of SLAR imagery of the United States (Alaska, the White Mountains of Vermont and New Hampshire, Nevada, and the Appalachian region of Maryland and West Virginia) acquired in 1982 by the USGS are given. It is noted that SLAR images are currently being analyzed by the USGS to support mapping of geological structures in the folded and thrust-faulted Appalachian Mountains, appraisal of geological hazards, and the monitoring of foliage cover for use in geological research.

B.J.

#### A85-12524#

##### DETECTIONS OF REGIONS OF OIL-FIELD EXPLOITATIONS AND THEIR INHERENT GEOLOGICAL STRUCTURES BY MEANS OF INFRARED SATELLITE DATA

H. KAMINSKI (Institut fuer Umwelt- und Zukunftsforschung, Bochum, West Germany) IN: *International Scientific Conference on Space*, 23rd, Rome, Italy, March 24, 25, 1983, *Proceedings*. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1984, p. 381-390. refs

NOAA-6 satellite imagery of the Algerian and Libyan Sahara desert is presented and discussed. The role of spectral bands in determining surface and cloud characteristics is summarized along with the factors which determine the characteristics of large-scale desert surface structures. An example of the recognition of gas-burning in the studied area with the 3.55-3.93 micron spectral band is presented.

C.D.

#### A85-12539#

##### EARTHQUAKE STUDIES IN ASWAN ENVIRONS, EGYPT, APPLYING SPACE-BORNE IMAGERY INTERPRETATION AND OTHER TECHNIQUES

E. M. EL SHAZLY and M. A. ABDEL HADY (Academy of Scientific Research and Technology, Remote Sensing Centre, Cairo, Egypt) IN: *International Conference on Space*, 24th, Rome, Italy, March 22, 23, 1984, *Proceedings*. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1984, p. 47-56. refs

#### A85-12547#

##### GEOLOGICAL EXPLORATION IN EGYPT USING REMOTE SENSING TECHNIQUES

L. V. MANESS, JR. (PetrolImage Corp., Golden, CO) IN: *International Conference on Space*, 24th, Rome, Italy, March 22, 23, 1984, *Proceedings*. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1984, p. 153-162. Research supported by the Asamera Oil of Canada. refs

The use of Landsat and SIR-A imagery as a geological exploration tool in Egypt are examined with reference to the study of potential-mineralization areas and petroleum exploration. Different sensors of Landsat and SIR-A measure parameters in different ways, enabling important distinctions about the earth surface to be made, which distinctions aid in the exploration for petroleum and minerals. Important measurable distinctions such as depth of penetration, sensitivity to ferric ions, sensitivity to chlorophyll, sensitivity to water, and reflectance enabled the generation of accurate geological maps, the delineation of geologically and botanically anomalous areas, and the definition of deep vs shallow water. This information has been effectively used in the exploration of the Red Sea and Gulf of Suez.

L.M.

## 04 GEOLOGY AND MINERAL RESOURCES

**A85-13074#**

**PSEUDO-COLOR COMPOSITE OF MULTI-BAND LANDSAT IMAGE PREPROCESSED THROUGH LASER ENHANCEMENT AND ITS APPLICATION TO GEOLOGICAL SCIENCE**

G. HU, Z. YANG, and P. LU (Beijing Institute of Environmental Features, Beijing, People's Republic of China) International Astronautical Federation, International Astronautical Congress, 35th, Lausanne, Switzerland, Oct. 7-13, 1984. 11 p. (IAF PAPER 84-127)

The pseudo-color composite image of multi-band black and white Landsat images which are enhanced in a Fourier optical system is made by pseudo-color composite equipment. It has a higher color contrast, more color levels, and clearer details than the color images made by nonpreprocessed Landsat images. In this paper, the pseudo-color composite images of 'Tuenshi frame' and 'Nanjing frame' are given as examples to illustrate the application of this color composite method to the geological construction analysis and prospecting for minerals. Author

**A85-14692\*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**ACTIVE AIRBORNE INFRARED LASER SYSTEM FOR IDENTIFICATION OF SURFACE ROCK AND MINERALS**

A. B. KAHLE, M. S. SHUMATE (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA), and D. B. NASH (Cincinnati, University, Cincinnati, OH) Geophysical Research Letters (ISSN 0094-8276), vol. 11, Nov. 1984, p. 1149-1152. NASA-supported research.

Emissivity and reflectivity in the thermal infrared spectral region (8-13 microns) may be used to discriminate among rocks and minerals. Although considerable success has been achieved in remote sensing classification of rock types based on emissivity measurements made with NASA's Thermal Infrared Multispectral Scanner (TIMS), classification based on reflectivity offers several advantages: much narrower bandwidths are used, higher signal to noise ratios are possible, and measurements are little affected by surface temperature. As a demonstration, an airborne CO<sub>2</sub> laser instrument was flown along the margin of Death Valley, California. Measurements of spectral reflectance collected with this device were compared with emissivity measurements made with the TIMS. Data from either instrument provided the means for recognizing boundaries between geologic units including different rock types and fan surfaces of different ages. Author

**A85-14693\*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**MAPPING ALLUVIAL FANS IN DEATH VALLEY, CALIFORNIA, USING MULTICHANNEL THERMAL INFRARED IMAGES**

A. R. GILLESPIE, A. B. KAHLE, and F. D. PALLUCONI (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) Geophysical Research Letters (ISSN 0094-8276), vol. 11, Nov. 1984, p. 1153-1156. NASA-supported research. refs

Alluvial fans have been mapped in Death Valley, California using NASA's 8-12 micron six-channel airborne Thermal Infrared Multispectral Scanner (TIMS). Both composition and relative age differences were recognized. Age unit boundaries are generally consistent with those obtained by conventional mapping. Composition was verified by field investigation and comparison with existing geologic maps. Bedrock and its young derived fan gravels have similar emissivities. The original composition of the fans is modified by differential erosion and weathering, permitting relative age mapping with TIMS. Author

**A85-16888**

**MODERN METHODS IN SATELLITE REMOTE SENSING AND EXAMPLES OF THEIR APPLICATION TO MINERAL AND GROUND WATER PROSPECTING [MODERNE METHODEN DER SATELLITENFERNERKUNDUNG MIT ANWENDUNGSBEISPIELEN AUS DER LAGERSTAETTENEXPLORATION UND GRUNDWASSERSUCHE]**

H. MOLLAT and R. MUEHLFELD (Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hanover, West Germany) Zeitschrift fuer Flugwissenschaften und Weltraumforschung (ISSN 0342-068X), vol. 8, Sept.-Oct. 1984, p. 335-337. In German.

Examples from the area of mineral and ground water exploration are used to demonstrate the practical significance of satellite remote sensing for the completion of large-scale, regional surveys. The importance of remote sensing for the Federal Republic of Germany and problems of facing its development there are considered. C.D.

**A85-16942**

**POSSIBILITIES REGARDING AN EMPLOYMENT OF AEROSPACE DATA FOR THE PREDICTION OF OIL-GAS POTENTIALS [VOZMOZHNOSTI PRIMENENIIA AEROKOSMICHESKIKH MATERIALOV PRI PROGNOZIROVANII NEFTEGAZONOSNOSTI]**

P. A. BIDZHIEV and L. M. NATAPOV (Proizvodstvennoe Geologicheskoe Ob'edinenie Aerogeologiya, Moscow, USSR) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), Sept.-Oct. 1984, p. 41-50. In Russian. refs

In the last few years, aerospace methods have been increasingly employed in applications related to the search for petroleum and gas deposits. The present investigation is concerned with the utilization of aerospace data in a study of the northern part of Western Siberia. The consideration of such data can lead to a substantial reduction in expenses arising in connection with requirements for a use of seismic surveying procedures. Attention is given to the employed method of investigation, the utilized data material, information concerning the basic structure and the sedimentary mantle in the north of Western Siberia, an analysis of details regarding aerospace data, and an evaluation of the obtained results. G.R.

**A85-17479**

**SPACE BORNE IMAGERY INTERPRETATION OF MEGA FEATURES RELATED TO EGYPTIAN ARCHEOLOGY**

E. M. EL SHAZLY (Academy of Scientific Research and Technology, Cairo, Egypt) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 6 p. refs

Landsat imagery interpreted in four MSS bands, color composites, and computer-compatible tapes has been used to delineate land features and lithologic units in Egypt which are of prehistoric or historic significance. The archaeological succession and chronology of Egypt based on these findings is summarized, emphasizing the importance of alternating pluvial and dry periods for that succession. Archaeological sites in the desert and Nile Basin are compared. C.D.

**A85-17510\*** Geological Survey, Reston, Va.

**IDENTIFICATION OF HYDROTHERMAL MINERALIZATION IN BAJA CALIFORNIA, MEXICO FROM ORBIT USING THE SHUTTLE MULTISPECTRAL INFRARED RADIOMETER**

L. C. ROWAN, J. K. CROWLEY, M. J. KINGSTON (U.S. Geological Survey, Reston, VA), and A. F. H. GOETZ (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 9 p. refs

Data from the Space Shuttle Multispectral IR Radiometer (SMIRR), which is a 10-channel remote sensor designed to record

narrow band spectral data in the 0.5-2.4 micron wavelength range, were used to identify and study a previously unreported area of hydrothermal alteration on the Baja California peninsula. Absorption at 2.17 microns, which is diagnostic of the minerals pyrophyllite, dickite, and alunite, was observed in many spectra and the presence of pyrophyllite and dickite was confirmed by X-ray diffraction analysis of field samples. Anomalously high Mo, B, Sn, Zr, and Ag were found in three samples. O.C.

**A85-17511\*** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**CORRELATION OF INFRARED REFLECTANCE RATIOS AT 2.3 MICRONS/1.6 MICRON AND 1.1 MICRON/1.6 MICRON WITH DELTA O-18 VALUES DELINEATING FOSSIL HYDROTHERMAL SYSTEMS IN THE IDAHO BATHOLITH**

A. R. GILLESPIE (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) and R. E. CRISS (U.S. Geological Survey, Menlo Park, CA) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 6 p. Research supported by the U.S. Geological Survey and NASA. refs

Reflectance ratios from laboratory spectra and airborne multispectral images are found to be strongly correlated with delta O-18 values of granite rocks in the Idaho batholith. The correlation is largely a result of interactions between hot water and rock, which lowered the delta O-18 values of the rocks and produced secondary hydrous material. Maps of the ratio of reflectivities at 2.3 and 1.6 microns should delineate fossil hydrothermal systems and provide estimates of alteration intensity. However, hydrous minerals produced during deuteric alteration or weathering cannot be unambiguously distinguished in remotely sensed images from the products of propylitic alteration without the use of narrow-band scanners. The reflectivity at 1.6 micron is strongly correlated with rock density and may be useful in distinguishing rock types in granitic terranes. V.L.

**A85-17550\*** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**QUANTITATIVE COMPARISONS OF RADAR IMAGE, SCATTEROMETER, AND SURFACE ROUGHNESS DATA FROM PISGAH CRATER, CA**

T. G. FARR and N. ENGHETA (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 6 p. NASA-supported research. refs

The relationships between radar image brightness and backscatter coefficient, between the backscatter coefficient and surface roughness, and between surface roughness and geology, must be established in order to satisfy criteria for the quantitative use of radar images. Attention is presently given to the merits of calibrated radar images and scatterometers as sources of the backscatter coefficient, theories that yield the coefficient on the basis of known surface roughness (and vice versa), and the geologic interpretation of surface roughness and backscatter signatures. These considerations are discussed in the case of the Pisgah Crater and lava field in the Mojave Desert of California. O.C.

**A85-17601**

**A HUE-SATURATION-INTENSITY TRANSFORM TO IMPROVE HYDROTHERMAL ALTERATION MAPPING**

G. L. RAINES and D. H. KNEPPER (U.S. Geological Survey, Denver, CO) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 3 p.

In many fields of science it has often been found that particular ways of measuring significantly simplify the analysis of some types of data. In remote sensing, a color-ratio-composite image made

from the Landsat multispectral scanner data is used to display processed sensor measurements that allow identification of limonitic materials by photointerpretation. Several problems exist in this photointerpretation task that are centered around the necessity of making subtle color discriminations on the image. These problems can be solved by transformation of the ratio data measure (a red-green-blue orthogonal data space) to the Munsell color measure (a hue-saturation-intensity cylindrical data space). This transformation is data independent and presents the ratios in a measure related to human perception of these ratios in the color image. Using this Munsell measure, perceived color differences in the image can be easily quantified and mapped. Different limonite mineralogies have been successfully mapped using Landsat data. Author

**A85-17602**

**USE OF REFLECTIVE SPECTRA AND DIGITAL PROCESSING TO IDENTIFY KIMBERLITE DIATREMES IN THE COLORADO-WYOMING DISTRICT**

J. E. MARKS and R. W. MARRS (Wyoming, University, Laramie, WY) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 3 p.

Diamonds are a strategic mineral, but the United States has no known domestic sources. Recently in Colorado and Wyoming, kimberlite pipes have been discovered. The previously used exploration techniques are both time consuming and costly. The University of Wyoming is developing an efficient and effective technique for detection of poorly exposed kimberlite diatremes by digitally processing 8-channel multispectral data. Digital processing techniques are applied to the scanner data to increase the spectral detectability of poorly exposed kimberlite in areas of known outcrop. Techniques which prove effective in these test areas are then applied over a broader region to detect unmapped kimberlite diatremes. Band ratios and factor analysis have thus far shown greatest promise for lithologic contrast enhancement. Author

**A85-17603**

**COMPARISON OF CALIBRATED AND UNCALIBRATED LANDSAT AND AIRBORNE THEMATIC MAPPER DATA FOR GEOLOGIC MAPPING**

S. E. MARSH and J. A. NEWCOMER (Sun Exploration and Production Co., Dallas, TX) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 7 p. refs

Past attempts at comparing and quantifying brightness values from multispectral scanner data have shown that to obtain interpretable and consistent results the digital data need to be converted to absolute radiometric units. A previously developed correction method which utilizes the field measured reflectance of surface materials to correct satellite or airborne scanner brightness values for extrinsic sensor and atmospheric effects was employed. The objective of this study was to compare classification results using calibrated and uncalibrated scanner data over an area in central Nevada. Results indicate that accounting for atmospheric and instrument response effects through data correction does not increase the discriminability of the geologic units present in the study area. Author

## 04 GEOLOGY AND MINERAL RESOURCES

**A85-17604\*** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

### **INTERPRETATION OF AIRCRAFT MULTISPECTRAL SCANNER IMAGES FOR MAPPING OF ALTERATION WITH URANIUM MINERALIZATION, COPPER MOUNTAIN, WYOMING**

J. E. CONEL (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 6 p. Research sponsored by the GEOSAT Committee, Inc. and NASA. refs

NS-001 multispectral scanner data (0.45-2.35 micron) combined as principal components were utilized to map distributions of surface oxidation/weathering in Precambrian granitic rocks at Copper Mountain, Wyoming. Intense oxidation is found over granitic outcrops in partly exhumed pediments along the southern margin of the Owl Creek uplift, and along paleodrainages higher in the range. Supergene(?) uranium mineralization in the granites is localized beneath remnant Tertiary sediments covering portions of the pediments. The patterns of mineralization and oxidation are in agreement, but the genetic connections between the two remain in doubt. Author

**A85-17605**

### **SUMMARY OF SOME ANALYSIS TECHNIQUES FOR LINEAR FEATURES WITH EXAMPLES FROM THE CASCADE RANGE**

D. H. KNEPPER, JR. (U.S. Geological Survey, Denver, CO) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 5 p. refs

Landsat multispectral scanner images are the basis of mapping for linear features representing topographic elements that are controlled by local geologic structures, thereby facilitating analyses for patterns indicative of regional geologic control. Linear features can be characterized according to their length, orientation, and distribution. Patterns with possible geological importance which are discovered by analysis can be compared with available regional geological, geophysical, and geochemical data for verification. O.C.

**A85-19100\*** Lunar and Planetary Inst., Houston, Tex.  
**A GEOLOGICAL INTERPRETATION OF SEASAT-SAR IMAGERY OF JAMAICA**

G. WADGE (Lunar and Planetary Institute, Houston, TX) and T. H. DIXON (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA; University of the West Indies, Saint Augustine, Trinidad and Tobago) Journal of Geology (ISSN 0022-1376), vol. 92, 1984, p. 561-581. NASA-supported research. refs

Spaceborne radar imagery obtained from Seasat allows an unobscured large-scale view of Jamaica that can be used for geological interpretation. Lineaments and textures visible in these images were mapped and compared with the known geology of the Tertiary karst limestones covering the central and western parts of the island. Some of these radar textures correlate with lithological units, while others follow tectonically-controlled zones or structural blocks. Mapping of radar lineaments has led to the recognition of three new aspects of Jamaican faults: (1) a major through-going NE-SW fault system, termed here the Vere-Annotto lineament; (2) a series of curving scissor faults in the central part of the island; and (3) the related observation that the dominant NNW-SSE tectonic fabric of the central part of the island takes the form of an elongate sigmoid in plan view. During most of the Neogene Jamaica has been part of an active zone of left-lateral transform motion between the Caribbean and North American plates and is a region of anomalous uplift. The radar imagery is a sensitive recorder of the deformation undergone by the karst limestones in this tectonic regime. Some of the observations are explained with models for a complex, evolving shear zone. Author

**N85-11026\*#** Geosat Committee, Inc., San Francisco, Calif.  
**INDUSTRIAL USE OF LAND OBSERVATION SATELLITE SYSTEMS**

F. B. HENDERSON, III IN: NASA. Marshall Space Flight Center 2nd Symp. on Space Industrialization p 97-101 Oct. 1984  
Avail: NTIS HC A19/MF A01 CSCL 05B

The principal industrial users of land observation satellite systems are the geological industries; oil/gas, mining, and engineering/environmental companies. The primary system used is LANDSAT/MSS. Currently, use is also being made of the limited amounts of SKYLAB photography, SEASAT and SIR-A radar, and the new LANDSAT/TM data available. Although considered experimental, LANDSAT data is now used operationally by several hundred exploration and engineering companies worldwide as a vastly improved geological mapping tool to help direct more expensive geophysical and drilling phases, leading to more efficient decision-making and results. Future needs include global LANDSAT/TM; higher spatial resolution; stereo and radar; improved data handling, processing distribution and archiving systems, and integrated geographical information systems (GIS). For a promising future, governments must provide overall continuity (government and/or private sector) of such systems, insure continued government R and D, and commit to operating internationally under the civil Open Skies policy. M.G.

**N85-11401** Indiana State Univ., Terre Haute.  
**THE FEASIBILITY OF SATELLITE REMOTE SENSING AS A TECHNIQUE FOR EVALUATING COAL MINE SURFACE FEATURES Ph.D. Thesis**

P. J. MADISON 1984 133 p  
Avail: Univ. Microfilms Order No. DA8416433

The potential for utilizing LANDSAT spectral signatures, instead of in-situ measurements, to determine values for various physical, chemical and biotic properties of coal mine surface features is discussed. The following five conclusions were derived: (1) a strong relationship was found between the measurements of the two data sets, with 94.7% of the variance between them accounted for by the first canonical variate; (2) statistically significant results were obtained using the spectral variables to predict relief, slope, vegetation type, vegetation density, parent material, surface temperature, moisture capacity, total organic carbon, and soil pH; (3) the distinct between class differences and minimal within class variations of the features studied resulted in only one significant spectral predictor of specific property values; (4) for minimally vegetated sites, the first principal component transformation (PC1) of the original LANDSAT data proved to be the best overall predictor; (5) prediction accuracy was increased substantially when categories were substituted for specific values of the criterion variables. In general, the study successfully demonstrated that LANDSAT spectral data could be used to predict statistically significant in situ measurements. Dissert. Abstr.

**N85-11411\*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.  
**GEOMORPHOLOGY**

IN: The Multispectral Imaging Sci. Working Group, Vol. 2 p 157-180 7 Sep. 1982 refs ERTS  
Avail: NTIS HC A15/MF A01 CSCL 05B

The study of geomorphology and terrain analysis using TM and MSS data are discussed. The spatial and spectral characteristics of a variety of landforms are also investigated. An outline of possible experiments and a summary of data requirements are included. M.A.C.

**N85-11413\*#** National Aeronautics and Space Administration, Washington, D. C.

**WORKSHOP ON THE USE OF FUTURE MULTISPECTRAL IMAGING CAPABILITIES FOR LITHOLOGIC MAPPING: WORKSHOP SUMMARY Final Report**

M. SETTLE and J. ADAMS (Washington Univ., Seattle) / In NASA. Goddard Space Flight Center The Spectral Imaging Sci. Working Group, Vol. 2 p 207-228 7 Sep. 1982 ERTS

Avail: NTIS HC A15/MF A01 CSCL 05B

Improved orbital imaging capabilities from the standpoint of different scientific disciplines, such as geology, botany, hydrology, and geography were evaluated. A discussion on how geologists might exploit the anticipated measurement capabilities of future orbital imaging systems to discriminate and characterize different types of geologic materials exposed at the Earth's surface is presented. Principle objectives are to summarize past accomplishments in the use of multispectral imaging techniques for lithologic mapping; to identify critical gaps in earlier research efforts that currently limit the ability to extract useful information about the physical and chemical characteristics of geological materials from orbital multispectral surveys; and to define major thresholds, resolution and sensitivity within the visible and infrared portions of the electromagnetic spectrum which, if achieved would result in significant improvement in our ability to discriminate and characterize different geological materials exposed at the Earth's surface.

B.G.

**N85-11420\*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

**HYPOTHESIS ON THE ORIGIN OF LINEAMENTS IN THE LANDSAT AND SLAR IMAGES OF PRECAMBRIAN SOIL IN THE LOW CONTAS RIVER VALLEY (SOUTHERN BAHIA) [UMA HIPOTESE SOBRE A ORIGEM DOS LINEAMENTOS DAS IMAGENS LANDSAT E SLAR NOS TERRENOS PRE-CAMBRIANOS DO BAIXO VALE DO RIO DE CONTAS (SUL DA BAHIA)]**

C. C. LIU, Principal Investigator and J. E. RODRIGUES Sep. 1984 26 p refs In PORTUGUESE; ENGLISH summary Sponsored by NASA ERTS

(E85-10007; NASA-CR-168559; NAS 1.26:168559;

INPE-3287-RPE/467) Avail: NTIS HC A03/MF A01 CSCL 05B

Examination of LANDSAT and SLAR images in southern Bahia reveals numerous linear features, which are grouped in five sets, based on their trends: N65 degrees E, N70 degrees W, N45 degrees E and NS/N15 degrees E. Owing to their topographic expressions, distributive patterns, spacing between individual lineaments and their mutual relationships, the lineament sets of N65 degrees E and N70 degrees W, as well as the sets of N40 degrees E and N45 degrees W, are considered as two groups of conjugate shear fractures and the former is older and is always cut by the latter. Their conjugate shear angles are 45 degrees and 85 degrees and their bisector lines are approximately in east-west and north-south directions, respectively. According to Badgley's argumentation on the conjugate shear angles, the former conjugate shear fractures would be caused by: (1) vertical movements, and the bisector of their conjugate angle would be parallel to the long axis of horsting or folding, or (2) by a compressive force in the east-west direction and under a condition of low confining pressure and temperature.

Author

**N85-11421\*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

**SYSTEMATIC DATA INTERPRETATION OF REMOTE SENSING IN THE RECEPTION OF HYDROCARBONS, VOLUME 1 M.S. Thesis [SISTEMATICA DE INTERPRETACAO DE DADOS DE SENSORIAMENTO REMOTO NA RECEPCAO DE HIDROCARBONETOS, VOLUME 1]**

F. P. DEMIRANDA, Principal Investigator Apr. 1984 177 p refs In PORTUGUESE; ENGLISH summary Sponsored by NASA ERTS 2 Vol.

(E85-10008; NASA-CR-168560; NAS 1.26:168560;

INPE-3087-TDL/162-VOL-1) Avail: NTIS HC A09/MF A01

CSCL 05B

The utilization of MSS-LANDSAT and RADAR imagery in the definition of morphostructural anomalies, which are indicative of hydrocarbon entrapment sites in the limit of the Middle and Lower Amazons basins was systemized. The identification and classification of the morphostructural anomalies were accomplished by means of the drainage network interpretation, based on the criteria previously proposed. Thirty anomalies were recognized, being subdivided into twenty domes, two fault controlled domes, six structural depressions, one fault controlled structural depression and one structure developed on a tilted fault block. Many anomalies are not randomly located. Rather, they seem to be aligned according to directions ENE and NNW, suggesting the presence of morphostructural trends in this part of the Amazons Basin. Significant orientations of lineaments were determined through statistical analysis, which defined many regional trends. The directions coincide with morphostructural trends orientations and with the directions of important structures in the Precambrian basement.

Author

**N85-11423\*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

**REMOTE SENSING AS A MINERAL PROSPECTING TECHNIQUE [SENSORIAMENTO REMOTO COMO TECNICA DE PROSPECCAO MINERAL]**

P. R. MENESES, Principal Investigator Apr. 1984 20 p refs In PORTUGUESE; ENGLISH summary Presented at the Simposio Brasil. de Tec. Exploratorias Apl. a Geologia, Salvador, Brazil, 18-21 Mar. 1984 Sponsored by NASA ERTS

(E85-10010; NASA-CR-168567; NAS 1.26:168567;

INPE-3051-PRE/472) Avail: NTIS HC A02/MF A01 CSCL 08B

Remote sensing and its application as an alternative technique to mineral resource exploration are reviewed. Emphasis is given here to the analysis of the three basic attributes of remote sensing, i.e., spatial attributes related to regional structural mapping, spectral attributes related to rock discrimination and seasonal attributes related to geobotanic anomalies mapping, all of which are employed in mineral exploration. Special emphasis is given to new developments of the Thematic Mapper of the LANDSAT-5, principally with reference to the application of the bands 1.6 and 2.2 microns to map hydrothermally altered rocks and the band of red and blue shift to geobotanical anomalies mapping.

Author

**N85-11430\*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

**MAPPING LAND USE CHANGES IN THE CARBONIFEROUS REGION OF SANTA CATARINA, REPORT 2 [MAPEAMENTO DA ALTERACAO DO USO DO SOLO NA REGIAO CARBONIFERA DE SANTA CATARINA - RELATORIO 2]**

D. D. VALERIANO, Principal Investigator and M. D. BITENCOURT PEREIRA Nov. 1983 35 p refs In PORTUGUESE; ENGLISH summary Sponsored by NASA Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS

(E85-10017; NASA-CR-168574; NAS 1.26:168574;

INPE-2945-RPE/447) Avail: NTIS HC A03/MF A01 CSCL 08B

The techniques applied to MSS-LANDSAT data in the land-use mapping of Criciuma region (Santa Catarina state, Brazil) are presented along with the results of a classification accuracy



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estimate tested on the resulting map. The MSS-LANDSAT data digital processing involves noise suppression, features selection and a hybrid classifier. The accuracy test is made through comparisons with aerial photographs of sampled points. The utilization of digital processing to map the classes agricultural lands, forest lands and urban areas is recommended, while the coal refuse areas should be mapped visually. Author

**N85-11438\*#** Purdue Univ., Lafayette, Ind. Dept. of Geosciences.

### **THE SOUTH-CENTRAL UNITED STATES MAGNETIC ANOMALY Final Report**

W. J. HINZE, L. W. BRAILE, Principal Investigators, and P. J. STARICH Jun. 1984 86 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS

(Contract NAG5-231)

(E85-10025; NASA-CR-174048; NAS 1.26:174048) Avail: NTIS HC A05/MF A01 CSCL 08G

The South-Central United States Magnetic Anomaly is the most prominent positive feature in the MAGSAT scalar magnetic field over North America. The anomaly correlates with increased crustal thickness, above average crustal velocity, negative free air gravity anomalies and an extensive zone of Middle Proterozoic anorogenic felsic basement rocks. Spherical dipole source inversion of the MAGSAT scalar data and subsequent calculation of reduced to pole and derivative maps provide constraints for a crustal magnetic model which corresponds geographically to the extensive Middle Proterozoic felsic rocks trending northeasterly across the United States. These felsic rocks contain insufficient magnetization or volume to produce the anomaly, but are rather indicative of a crustal zone which was disturbed during a Middle Proterozoic thermal event which enriched magnetic material deep in the crust. M.G.

**N85-11440\*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

### **THEMATIC MAPPING OF LIKELY TARGET AREAS FOR THE OCCURRENCE OF CASSITERITE IN THE SERRA DO MOCAMBO (GO) GRANITIC MASSIFS USING LANDSAT 2 DIGITAL IMAGING [MAPEAMENTO TEMATICO DE AREAS-ALVOS FAVORAVEIS A OCORRENCIA DE CASSITERITA NO MACICO GRANITICO DA SERRA DO MOCAMBO (GO), A PARTIR DE IMAGENS DIGITAIS DO LANDSAT-2]**

R. ALMEIDOFILHO, Principal Investigator Jun. 1984 16 p refs In PORTUGUESE; ENGLISH summary Presented at the 33rd Congr. Brasil. de Geologia, Rio de Janeiro, 28 Oct. - 4 Nov. 1984 Sponsored by NASA Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS

(E85-10027; NASA-CR-174050; NAS 1.26:174050; INPE-3153-PRE/532) Avail: NTIS HC A02/MF A01 CSCL 05B

The applicability of LANDSAT/MSS images, enhanced by computer derived techniques, as essential tools in mineral research was investigated and the Serra do Mocambo granitic massif was used as illustration. Given the peculiar factors founded in this area, orbital imagery permitted the delineation of potential target areas of mineralization occurrences, associated to albitized/greisenized types. Follow up prospection for primary tin deposits in this granitic massif should be restricted to the delineated areas which are less than 5% of the total superficial area of the massif. M.G.

**N85-11443#** Geological Survey, Washington, D.C.

### **THE ALASKAN MINERAL RESOURCES ASSESSMENT PROGRAM: GUIDE TO INFORMATION CONTAINED IN THE FOLIO OF GEOLOGIC AND MINERAL-RESOURCE MAPS OF THE MEDFRA QUADRANGLE, ALASKA**

W. W. PATTON, JR., E. J. MOLL, and H. D. KING 1984 16 p refs

(GS-CIRC-928; LC-84-600057) Avail: NTIS HC A02/MF A01

The Medfra quadrangle in west-central Alaska was investigated by a multidisciplinary team of geoscientists to assess its mineral resources. This Circular is intended to serve as a guide to a folio of 13 separate Open-File Reports covering various aspects of these investigations, including geology, bedrock and stream-sediment geochemistry, potassium-argon dating, LANDSAT imagery, mineral occurrences, aeromagnetic interpretation, and mineral-resource assessment. This circular presents a complete reference list of these reports and a summary of the important results of each of the investigations. Author

**N85-11444\*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

### **SHUTTLE EXPERIMENTAL RADAR FOR GEOLOGICAL EXPLORATION (SERGE) PROJECT: FIELD WORK RELATING TO THE SHUTTLE EXPERIMENTAL RADAR A (SIR-A) IN BRAZIL (PHASE 2) [PROJETO SERGE: TRABALHO DE CAMPO REFERENTE AO EXPERIMENTO SIR-A NO BRASIL (FASE 2)]**

M. G. BALIEIRO, P. R. MARTINI, J. R. DOSSANTOS, and J. T. DEMATTOS Aug. 1984 197 p refs In PORTUGUESE; ENGLISH summary Sponsored by NASA

(NASA-CR-174033; NAS 1.26:174033; INPE-3259-NTE/223)

Avail: NTIS HC A09/MF A01 CSCL 05B

The ground observations undertaken over the northern position of Minas Gerais State, and part of Distrito Federal from 7 to 12 December 1982, along the Space Shuttle 2 flying orbit 22 of November 1981 are described. Field data related mostly with lithology, geological structures and forest cover, and specific geomorphological and pedological aspects were collected. Ground data are applied to evaluate the SIR-A Experiment, developed in the Space Shuttle-2 mission for natural resources mapping and prospecting. Author

**N85-11446#** Army Engineer Topographic Labs., Fort Belvoir, Va.

### **TERRAIN ANALYSIS PROCEDURAL GUIDE FOR SURFACE CONFIGURATION Technical Report**

O. MINTZER and J. A. MESSMORE Mar. 1984 268 p

(AD-A145637; ETL-0352) Avail: NTIS HC A12/MF A01 CSCL 15D

This guide is an instructional manual for the use by the U.S. Army Terrain Analyst when preparing the following factor overlays: slope, landform, and surface roughness. These overlays are constructed from the analysis of the combined data extracted from literature, topographic maps, and aerial/LANDSAT imagery. A catalog section includes the descriptions of photo pattern, topographic map, and surface roughness data elements for thirty-seven typical topographic/geologic forms. Additional topics include: Remote sensing, Military geographic information, Geology/Soils, Factor Mapping, Aerial Photography, and Photointerpretation. GRA



**N85-12412\*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

**ASSESSMENT OF COMPUTER TECHNIQUES FOR PROCESSING DIGITAL LANDSAT MSS DATA FOR LITHOLOGICAL DISCRIMINATION OF SERRA DO RAMALHO, STATE OF BAHIA [AVALIACAO DE TECNICAS DE TRATAMENTO FOR COMPUTADOR DE DADOS DIGITAIS MSS-LANDSAT NA DISCRIMINACAO LITOLOGICA NA SERRA DO RAMALHO, ESTADO DA BAHIA]**

W. R. PARADELLA, Principal Investigator, I. VITORELLO, and M. D. MONTEIRO (Companhia Baiana de Pesquisa Mineral, Salvador, Brasil) Aug. 1984 35 p refs In PORTUGUESE; ENGLISH summary Presented at the 2nd Simp. Brasil. de Sensoriamento Remoto, Brasilia, 10-14 May 1982 Sponsored by NASA Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. 57198 ERTS (E85-10033; NASA-CR-174124; NAS 1.26:174124; INPE-3250-PRE/592) Avail: NTIS HC A03/MF A01 CSCL 08G

Enhancement techniques and thematic classifications were applied to the metasediments of Bambui Super Group (Upper Proterozoic) in the Region of Serra do Ramalho, SW of the state of Bahia. Linear contrast stretch, band-ratios with contrast stretch, and color-composites allow lithological discriminations. The effects of human activities and of vegetation cover mask and limit, in several ways, the lithological discrimination with digital MSS data. Principal component images and color composite of linear contrast stretch of these products, show lithological discrimination through tonal gradations. This set of products allows the delineations of several metasedimentary sequences to a level superior to reconnaissance mapping. Supervised (maximum likelihood classifier) and unsupervised (K-Means classifier) classification of the limestone sequence, host to fluorite mineralization show satisfactory results. M.G.

**N85-12415\*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

**EVALUATION OF CRITERIA FOR SELECTING THE SPECTRAL ATTRIBUTES OF DIGITAL LANDSAT MSS IMAGERY FOR DISCRIMINATING LITHOLOGICAL UNITS IN THE LOWER CURACA RIVER VALLEY, BAHIA [AVALIACAO DE CRITERIOS DE SELECAO DE ATRIBUTOS ESPECTRAIS DE IMAGENS DIGITAIS MSS-LANDSAT, EM DISCRIMINACOES LITOLOGICAS NO BAIXO VALE DO RIO CURACA, BAHIA]**

W. R. PARADELLA, Principal Investigator Aug. 1984 34 p refs In PORTUGUESE; ENGLISH summary Submitted for publication Sponsored by NASA Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. 57198 ERTS (E85-10036; NASA-CR-174127; NAS 1.26:174127; INPE-3248-PRE/591) Avail: NTIS HC A03/MF A01 CSCL 08F

The use of spectral attributes criteria was investigated, based on measures of statistical distance of separability between thematic classes in MSS digital LANDSAT imagery, in order to select the best subsets of channels in composite colors for the detection and discrimination of lithological units in the lower valley of Curaca River, State of Bahia, Brazil. Three situations were investigated: (1) selection of the three best channels, considering all of the original bands (channels 4, 5, 6, and 7); (2) selection of the three best bands, considering the six MSS band-ratios (channels 4/5, 4/6, 4/7, 5/6, 5/7, and 6/7); and (3) selection of the three best bands in a hybrid approach (the four original bands and the six ratios). A visual analysis was done on color composite images using the selected sets. Results show that the hybrid product (bands 4, 5/7, and 7 with green, blue, and red respectively) and the Normal Color Composite (bands 4, 5, and 7 with blue, green, and red colors respectively) had the best performance. R.S.F.

**N85-13283#** Geological Survey, Alexandria, Va.

**THE UNITED STATES GEOLOGICAL SURVEY IN ALASKA: ACCOMPLISHMENTS DURING 1981**

W. L. COONRAD, ed. and R. L. ELLIOTT, ed. 1984 175 p refs (USGS-CIRC-868; LC-76-608093) Avail: Issuing Activity

Summary and topical accounts of the results of studies on a wide range of topics of economic and scientific interest are contained. In addition, many more detailed maps and reports are included in the lists of references cited for each article and in the appended compilations of 277 reports on Alaska published by the U.S. Geological Survey and of 103 reports by U.S. Geological Survey authors in various other scientific publications.

**N85-13284#** Geological Survey, Alexandria, Va.

**SUMMARY OF LANDSAT QUADRANGLE STUDIES IN ALASKA**

J. R. LECOMPTE, W. C. STEELE, and N. R. D. ALBERT In *its* The United States Geol. Survey in Alaska p 1-4 1984 refs Avail: Issuing Activity

LANDSAT-image interpretation and (or) LANDSAT feature maps for 27 Alaskan 1:250,000-scale quadrangles were completed. Synthesis of the data compiled indicates that the major features commonly observable on the LANDSAT images of Alaska are lineaments, circular and arcuate features, and anomalously colored areas. B.G.

**N85-13285#** Geological Survey, Alexandria, Va.

**DIGITAL ELEVATION MODELS IMPROVE PROCESSING OF ALASKAN GRAVITY DATA**

D. F. BARNES In *its* The United States Geol. Survey in Alaska p 5-6 1984 refs Avail: Issuing Activity

The recent availability of an almost complete file of digital elevation models (DEM's) for Alaska makes possible new maps and calculations, including the terrain and isostatic correction of the gravity data used to prepare the previous gravity map of Alaska. This refinement of data, once suitable only for small-scale regional maps of mountainous areas, now makes the same useful for larger scale maps and for such quantitative interpretative procedures as digital modeling. The DEM's consist of metric elevations on a nearly square (commonly 3 by 6 second) geographic grid derived from 1:250,000-scale topographic maps and available on magnetic tapes. New computer techniques to read these tapes now permit terrain corrections on the gravity data accumulated over the past 20 to 30 years, and future programs will provide isostatic, mean-elevation, and other maps. B.G.

**N85-13286#** Geological Survey, Alexandria, Va.

**SEISMIC STUDIES IN SOUTHERN ALASKA**

C. D. STEPHENS, J. C. LAHR, and R. A. PAGE In *its* The United States Geol. Survey in Alaska p 7-9 1984 refs Avail: Issuing Activity

Analysis of seismic data from the network in southern Alaska has focused on shallow seismicity in three areas: the Yakutat seismic gap along the northeastern Gulf of Alaska, the southern Kenai Peninsula, and the active volcanoes west of Cook Inlet. A summary of the results for each of these areas is presented.

Author

**N85-13289#** Geological Survey, Alexandria, Va.

**THE KANAYUT CONGLOMERATE IN THE WESTERNMOST BROOKS RANGE, ALASKA**

T. H. NILSEN and T. E. MOORE In *its* The United States Geol. Survey in Alaska p 12-16 1984 refs Avail: Issuing Activity

The Upper Devonian and Lower Mississippian(?) Kanayut Conglomerate is an allochthonous coarse grained clastic unit that forms a distinctive and mappable stratigraphic unit in the central and eastern Brooks Range. It is as thick as 3,000 m and has been divided, in ascending order, into the Ear Peak Member, Shainin Lake Member, and Stuver Member. The Ear Peak and Stuver members typically contain multiple fining- and thinning-upward cycles that appear to be characteristic of

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deposition by meandering streams, whereas the Shainin Lake Member typically contains more massive outcrops of conglomerate and sandstone that appear to be characteristic of deposition by braided streams. Conglomerate of the Kanayut is composed of chert, quartzite, and quartz clasts, and the sandstone is typically orthoquartzitic in composition. The Kanayut records outbuilding of a major dominantly fluvial deltato the south and west. It has generally been considered to pinch out laterally to the south and west into age-equivalent units. Its presence in Paleozoic stratigraphic sequences in the Husky Mountains and the Mulgrave Hills at the westernmost margin of the Brooks Range is documented. A.R.H.

**N85-13290#** Geological Survey, Alexandria, Va.  
**GEOHERMAL STUDIES IN ALASKA: CONDITIONS AT PRUDHOE BAY**

A. H. LACHENBRUCH, J. H. SASS, B. V. MARSHALL, T. H. MOSES, JR., R. J. MUNROE, and E. P. SMITH *In its* The United States Geol. Survey in Alaska p 19-20 1984 refs  
Avail: Issuing Activity

The thermal regime in the Prudhoe Bay area on the coast of the Beaufort Sea was studied on the basis of temperature measurements through permafrost in the Prudhoe Bay oilfield. Analysis of these data, and of thermal conductivity measurements on samples of drill cuttings and frozen core indicate: (1) the heat flow from the Earth's interior is  $1.3 \pm 0.2$  heat-flow units (HFU) ( $55 \pm 10$  mW/sq sq m), a value typical of stable continental regions; (2) the permafrost on land near Prudhoe Bay extends to a depth of 630+ m, 50 to 100 percent deeper than permafrost in the Barrow area. This greater depth is caused by the high thermal conductivity of the coarse ice-rich siliceous sediment in the Prudhoe Bay area, (3) in the Prudhoe Bay area the annual increase averages about 1.8 C (from -10.9 C to -9.1 of temperature C) and is associated with a net accumulation of 5 to 6 kcal/sq cm by the Earth's surface during this period, and (4) rising sea level and thawing seacliffs probably caused the shoreline to advance tens of kilometers in the past 20,000 years, so that a part of the Continental Shelf that is presently the target of intensive oil exploration was inundated. A simple heat-conduction model suggests that the warm seabed will cause the base of ice-rich permafrost to rise about 10 m (from 60+ or - m) during the first 2,000 years after inundation, and thereafter it will rise about 15 m per 1,000 years. A.R.H.

**N85-13293#** Geological Survey, Alexandria, Va.  
**NEW AGES OF RADIOLARIAN CHERT FROM THE RAMPART DISTRICT, EAST-CENTRAL ALASKA**

D. L. JONES, N. J. SILBERLING, R. M. CHAPMAN, and P. CONEY *In its* The United States Geol. Survey in Alaska p 39-43 1984 refs  
Avail: Issuing Activity

Sedimentary rocks of the Rampart Group in east-central Alaska are dominantly deep water chert, argillite, andesitic volcanoclastic rocks, and very minor tuffaceous bioclastic limestone. Dated rocks range in age from Late Mississippian to Permian, and float blocks suggest the presence of Upper Triassic strata. Radiolarian chert, structurally associated with graywacke and argillite of the Mesozoic flysch belt south of Rampart, is Triassic; its presence may indicate that clastic sedimentation within this belt commenced much earlier than hitherto suspected. R.S.F.

**N85-13297#** Geological Survey, Alexandria, Va.  
**LATE PALEOZOIC AND EARLY MESOZOIC RADIOLARIANS IN THE CIRCLE QUADRANGLE, EAST-CENTRAL ALASKA**

H. L. FOSTER, G. W. CUSHING, F. R. WEBER, D. L. JONES, B. MURCHEY, and C. D. BLOME *In its* The United States Geol. Survey in Alaska p 62-64 1984 refs  
Avail: Issuing Activity

Late Paleozoic and early Mesozoic radiolarians were found in slightly metamorphosed chert north of the Tintina fault system in the Circle quadrangle was identified. Most of the samples which contain identified radiolarians, in the northern part of the eastern Crazy and Little Crazy Mountains, indicate that these rocks include

chert of two distinct ages: late Mississippian or early Pennsylvanian, and middle and late Triassic. The age of the Circle Volcanics is considered to be late Paleozoic and Triassic. E.A.K.

**N85-13302#** Geological Survey, Alexandria, Va.  
**PALEOMAGNETIC LATITUDE OF PALEOCENE VOLCANIC ROCKS OF THE CANTWELL FORMATION, CENTRAL ALASKA**  
J. W. HILLHOUSE and S. GROMME *In its* The United States Geol. Survey in Alaska p 80-82 1984 refs  
Avail: Issuing Activity

The Cantwell basin in the central Alaska Range consists of the Cantwell Formation, which includes, in its upper part, calc-alkaline volcanic rocks and intrusive rocks. The present distributions of the volcanic and sedimentary rocks of the Cantwell Formation is shown. Potassium-argon ages determined from the extrusive and intrusive rocks, which range from 41.8 to 60.6 m.y., are considered to be minimum ages at least in part. These ages accord with the Paleocene age of plant fossils in the Cantwell Formation. The entire Cantwell Formation was extensively folded and faulted, and local angular unconformities occur between the volcanic and sedimentary rocks. It was concluded that the natural magnetization in 18 lava flows studied is thermoremanent magnetization acquired during initial cooling. All lavas exhibited reversed polarity, as is appropriate for their age because Paleocene time was dominated by periods of reversed geomagnetic polarity. R.J.F.

**N85-13304#** California Inst. of Tech., Pasadena. Div. of Geological and Planetary Sciences.  
**PROGRESS IN LEAD/URANIUM ZIRCON STUDIES OF LOWER PALEOZOIC ROCKS OF THE SOUTHERN ALEXANDER TERRANE**

J. B. SALEEBY, G. E. GEHRELS, G. D. EBERLEIN (Geological Survey, Alexandria, Va.), and H. C. BERG (Geological Survey, Alexandria, Va.) *In its* Geological Survey The United States Geol. Survey in Alaska p 110-113 1984 refs  
Avail: Issuing Activity

Geologic mapping and zircon lead/uranium geochronologic studies on southern Prince of Wales Island and southern Annette Island delineated a regional metaigneous complex that ties these two areas together during Ordovician and, possibly, earlier time. Metamorphic-mineral assemblages and fabrics indicate metamorphism to greenschist to amphibolite facies under both static and dynamic conditions. R.J.F.

**N85-13306#** Geological Survey, Alexandria, Va.  
**CRETACEOUS PLUTONIC ROCKS, MITKOF AND KUPREANOF ISLANDS, PETERSBURG QUADRANGLE, SOUTHEASTERN ALASKA**

P. D. BURRELL *In its* The United States Geol. Survey in Alaska p 124-126 1984 refs  
Avail: Issuing Activity

Reconnaissance geologic mapping and preliminary petrologic studies of a group of similar granitic bodies in a northwest-trending belt in the eastern part of the Petersburg quadrangle suggest that these bodies can be divided into subgroups which are mineralogically similar but texturally distinct. These rocks are all part of the Admiralty-Revillagigedo plutonic belt, which extends from Ketchikan to Juneau, outboard of the Coast plutonic complex; they intrude metamorphic rocks of the Gravina-Nutzotin belt. Textural differences in these granitic bodies are cited. B.W.

**N85-13359#** Instituto de Pesquisas Espaciais, Sao Paulo (Brazil).

**REPORT OF THE FIELD WORK PERFORMED IN THE BASINS OF THE QUEBRA OSSO AND TANQUE PETRO RIVERS IN THE CATAS ALTAS QUADRANGLE, MINAS GERAIS [RELATORIO DO TRABALHO DE CAMPO REALIZADO NAS BACIAS DOS RIOS QUEBRA OSSO E TANQUE PRETO, NA QUADRICULA DE CATAS ALTAS, MINAS GERAIS]**

A. R. DOSSANTOS, M. P. BARBOSA, and P. VENEZIANI Sep. 1984 58 p refs In PORTUGUESE; ENGLISH summary (INPE-3268-NTE/225) Avail: NTIS HC A04/MF A01

The specific objective of this geological mapping in the region of Santa Barbara (MG) in the scale of 1:8,000, was to get acquainted with the lito-structural and tectonic evolution of the Quebra Osso and Nova Lima rocks part of the Greenstone Belt and its old basement. Author

**N85-13406\*#** National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

**PETROLOGIC MODEL OF THE NORTHERN MISSISSIPPI EMBAYMENT BASED ON SATELLITE MAGNETIC AND GROUND BASED GEOPHYSICAL DATA**

H. H. THOMAS Jul. 1983 16 p refs Submitted for publication (NASA-TM-85075; NAS 1.15:85075) Avail: NTIS HC A02/MF A01 CSCL 08G

Magnetization, derived from gravity-seismic data from the northern Mississippi Embayment, is evaluated relative to magnetization values obtained from satellite magnetic data. A magnetization contrast of approximately -0.54 A/m determined from the geophysical model compares favorably to a value of approximately -0.47 A/m from MAGSAT United States Apparent Magnetization contrast map. The negative magnetization contrast, required by the MAGSAT data, is unusual as rift zones with the exception of those which are currently active are associated with positive magnetization. The model presented favors an intrusion of low Curie temperature mafic rock at the base of the crust. Alternate possibilities, a shallow Curie isotherm or remanence in a direction other than that of the current main field, seem less likely as reported regional heat flow values are too low and remanence is attenuated at depth. Author

**N85-14207#** Centre National de la Recherche Scientifique, Valbonne (France). Centre de Recherches Archeologiques.

**METHODOLOGICAL RESEARCH IN CONNECTION WITH THE HANDLING OF LANDSAT SATELLITE DATA FOR ARCHAEOLOGY**

E. BARISANO In ESA EARSeL/ESA Symp. on Integrative Approaches in Remote Sensing p 47-49 Aug. 1984 refs Avail: NTIS HC A17/MF A01

The use of satellites by archaeologists is discussed. Given the limits of satellite spatial resolution, the observable phenomena cannot be the size of the real archaeological site, but the images give precise indications as to such archaeological phenomena of linear type as Roman reticulum, roads, drainage canals, and irrigation. There is also a range of indirect indications connected to natural factors. Satellite data are of value for the knowledge of a region in every aspect: physiographic, hydrological, geomorphological, ecological, quality of soils, presence of underground water, drainage structure etc., which gives the information necessary to study paleogeography in general. Author (ESA)

**N85-14208#** Trinity Coll., Dublin (Ireland). Remote Sensing Applied Research Group.

**METHODS FOR CORRELATING GEOLOGICAL, GEOCHEMICAL AND GEOPHYSICAL DATA WITH SATELLITE IMAGERY IN CENTRAL IRELAND**

M. F. CRITCHLEY, W. E. A. PHILIPS, and D. W. COLLIER In ESA EARSeL/ESA Symp. on Integrative Approaches in Remote Sensing p 51-53 Aug. 1984 refs Avail: NTIS HC A17/MF A01

Methods of integrating a remote sensing data base with a geological data base were developed to help in exploration of lead-zinc ore bodies in Ireland. These are stratiform deposits hosted in Lower Carboniferous (Tournasian) limestones. The area is heavily covered by glacial overburden, which obscures the underlying geology. Despite the overburden, remote sensing can be used to map structures in the Carboniferous limestones. Geological evidence suggests that mineralization is associated with faulting, so images of lineaments are analyzed statistically to produce contour maps of possible mineral zones. Discriminant analysis is used to devise a classification model to distinguish between mineralized and unmineralized areas. Author (ESA)

**N85-14244#** Technische Univ., Munich (West Germany). Working Group Geoscientific Remote Sensing.

**A MULTIPLE APPROACH IN REMOTE SENSING FOR STRUCTURAL AND LITHOLOGICAL MAPPING BY USE MODULAR OPTOELECTRONIC MULTISPECTRAL SCANNER (MOMS)/LANDSAT/HEAT CAPACITY MAPPING MISSION (HCMM) DATA**

H. KAUFMANN In ESA EARSeL/ESA Symp. on Integrative Approaches in Remote Sensing p 337-347 Aug. 1984 refs Avail: NTIS HC A17/MF A01

A concept for processing and presenting HCMM, LANDSAT, and Modular Optoelectronic Multispectral Scanner data for studies of geological structures is outlined. Using digital image processing techniques, data are prepared for structural and lithological mapping, and optimized for qualitative and quantitative analysis. These data, of different sensors acquired in multispectral and multitemporal mode, are used to correlate surface features and localized with their expression in satellite imagery. Images from semiarid and arid zones are shown. Author (ESA)

**N85-15216#** Joint Publications Research Service, Arlington, Va. **GEOLOGICAL EFFECTIVENESS OF AUTOMATED PROCESSING OF HIGHLY PRECISE AEROMAGNETIC SURVEYS IN CASPIAN REGION Abstract Only**

V. A. BORONAYEV, L. A. KOVAL, V. I. SERKOV, M. I. KALININ, and R. G. KOMAROVA In its USSR Rept.: Earth Sci. (JPRS-UES-84-007) p 116 10 Dec. 1984 Transl. into ENGLISH from Izv. Akad. Nauk Kazakhsk. SSR: Ser. Geol. (Alma-Ata), no. 3, May - Jun. 1984 p 65-77 Avail: NTIS HC A08

The ASOM-AGS/Yes system is intended for the processing and interpretation of data from aerogeophysical surveys on Yes computers. Using this system there can be separate or combined processing of magnetic, gamma-spectral and electrical prospecting data with a topographic tie-in by different methods. A block diagram shows a generalized scheme for processing in the ASOM-AGS/Yes system. A highly precise aeromagnetic survey at 1:50,000 in the area of the Caspian depression and on the Mangyshlak Peninsula with an accuracy to 1 gamma is described. Specific details are given concerning this survey work, both the procedures used and the results obtained. The automated processing of these aerogeophysical data involves four successive stages: initial processing; various operations ensuring thorough qualitative and semiquantitative analysis; quantitative interpretation; and formation of an archives of aerogeophysical and geological data on magnetic tapes, interaction of the system with the computer archives, geological generalization, and interpretation of the accumulated information. R.J.F.

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**N85-15645\*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

### **SEARCHING FOR IMPACT CRATERS USING SPACE SHUTTLE PHOTOGRAPHY Abstract only**

C. A. WOOD, C. DAILEY (Lockheed Engineering and Management Services Co., Houston, Tex.), W. DALEY (Lockheed Engineering and Management Services Co., Houston, Tex.), and G. WELLS (Lockheed Engineering and Management Services Co., Houston, Tex.) *In* Lunar and Planetary Institute The 47th Ann. Meteoritical Soc. Meeting 1 p 1984 refs

Avail: NTIS HC A10/MF A01 CSCL 08E

Extrapolation of impact cratering rates derived from Canada and Europe suggests that in the cratonic regions of Australia, India, Africa, and Brazil, 14-15 impact craters 20 km diameter should have formed during the last 120 my, and survived erosional erasure. In fact, in these areas, only 2 craters are known that approximately qualify: (1) Gosses Bluff, 22 km, 130 + or - 6 my old, and; Strangways, 24 km and 150 + or - 70 my old. It is therefore likely that about a dozen relatively large and preserved impact craters await discovery in these less explored cratons. A larger number of younger and smaller craters must also exist. An informal search is reported for impact craters using photographs obtained by Shuttle astronauts. Photographs taken with the 250 mm lens on Hassalblad cameras have a resolution of 25 m and cover a nominal area of 50x60 sq km. A larger format Linhof camera with similar resolution but 4 times larger area was flown March 1984, and will fly again in the future. Shuttle imagery has numerous advantages in looking for impact craters and for other types of Earth observations. B.W.

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### **OCEANOGRAPHY AND MARINE RESOURCES**

Includes sea-surface temperature, ocean bottom surveying imagery, drift rates, sea ice and icebergs, sea state, fish location.

**A85-10204#**

### **KUBELKA-MUNK ANALYSIS APPLIED TO MULTI-PLATFORM REMOTE SENSING OF CHLOROPHYLL PIGMENTS**

S. HAYAKAWA, T. DOIHARA (Asia Air Survey Co., Ltd., Tokyo, Japan), and Y. IWANAGA (Environmental Agency of Japan, Tokyo, Japan) *IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 1 . Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 425-434. refs*

To determine chlorophyll pigments remotely in large bodies of sea water, it is necessary to attempt to simulate the optical characteristics of natural water in the laboratory by a four-component optical model derived from Kubelka-Munk analysis. Previously, this has always been predicted from in situ measurement. The analysis examines the optimum wave-length bands (blue and red regions) to detect chlorophyll pigments and presents reasonable and/or convenient methodology that computes the reflectance differences between those bands. Based upon this analysis, the amount of chlorophyll pigments is estimated from high altitude airborne MSS and also, statistically, from Landsat MSS. Author

**A85-10213#**

### **DEVELOPMENT OF ATMOSPHERIC CORRECTION ALGORITHMS FOR NIMBUS-7 CZCS, LANDSAT MSS AND MOS-1 MESSR**

Y. SASAKI, I. ASANUMA, K. MUNAYAMA (Japan Marine Science and Technology Center, Yokosuka, Japan), Y. EMORI, Y. YASUDA (Chiba University, Chiba, Japan), J. IISAKA (Maryland, University, College Park, MD), and Y. TOZAWA (IBM Japan, Tokyo Scientific Center, Tokyo, Japan) *IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 2 . Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 579-588. refs*

Japan is going to launch MOS-1 (Marine Observation Satellite-1) in 1986, which is to be furnished with MESSR (Multispectral Electronic Self-Scanning Radiometer), the visible and near infrared sensor, and with two other sensors. The main purpose of this work is to propose a method for estimating aerosol path radiances in the visible bands from that in the near infrared band in MESSR data processing. Analyses for this purpose were made using the sea truth and air truth data obtained in Tokyo Bay. It was suggested from the simulation that it might be reasonable to estimate aerosol path radiances in the visible region from that in the near infrared region in the case of less atmospheric water vapor contents. The same suggestion was obtained through analyses of Landsat MSS data combined with the sea truth and air truth data obtained in Sagami Bay. Author

**A85-10214#**

### **APPLICATION OF THE BAYES DECISION RULE FOR AUTOMATIC WATER MASS CLASSIFICATION FROM SATELLITE INFRARED DATA**

R. E. COULTER (U.S. Naval Oceanographic Office, Bay Saint Louis, MS) *IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 2 . Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 589-597.*

Fronts and water masses of the northwest Atlantic Ocean are detected in satellite infrared images by an automated classification procedure. The classification algorithm is composed of the Bayes Decision Rule which uses historical data compiled from this region. The Decision Rule operates such that, among a given set of ocean fronts and water masses, each pixel is associated with the most probable class. The probabilities that pixels indicate particular fronts and water masses are computed from the historical locations of these classes and from probability density functions which themselves are based upon the historical sea surface temperature field. Two applications of the classifier compare favorably with more traditional, manual interpretations of the images. Author

**A85-10215#**

### **EVALUATION OF CZCS AND LANDSAT FOR COASTAL OPTICS AND WATER PROPERTIES**

R. A. ARNONE (U.S. Navy, Naval Ocean Research and Development Activity, Bay Saint Louis, MS) *IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 2 . Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 599-608. refs*

The application of using CZCS and Landsat imagery for monitoring coastal water properties has been demonstrated for the Northern Gulf of Mexico. Optical water properties are closely related to the upwelling radiation of the water column which satellite systems are responsive. The use of atmospheric correction techniques to obtain absolute upwelling radiation were applied to coastal areas in the Mississippi Sound and were found not to be applicable for these coastal waters. Problems with the atmospheric correction were attributed to: (1) incorrect assumptions of zero upwelling radiation at 670 nm for coastal waters and (2) spatial variation of the angstrom coefficient within the image. The utility of satellite systems to measure coastal water properties is more limited than for deeper ocean waters. An evaluation of Landsat and CZCS for detecting coastal features indicates the increased resolution for Landsat is significant in highly turbid areas. The

increased sensitivity and specific spectral ranges of CZCS are not required for detecting strong color gradients. However, for more subtle color changes and for measuring the temporal variability along coastal waters, CZCS is more applicable. Author

**A85-10255#****DIGITAL IMAGE PROCESSING SOFTWARE IN INTERACTIVE MODE G.I.P.S.Y.**

G. BELBEOCH (Centre National Pour l'Exploitation des Oceans, Brest, France) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 1085-1089.

The GIPSY (General Image Processing System) software for debugging digital image analysis methods for oceanological research is discussed. The main characteristics of GIPSY are listed and an outline is presented of its various modules and their main characteristics. A simple example of the application of GIPSY to remote sensing data is given, showing what some of the modules do. C.D.

**A85-10258#****GAIN COMPRESSION EFFECTS IN SAR IMAGERY**

C. E. LIVINGSTONE, D. HUDSON (Canada Centre for Remote Sensing, Ottawa, Canada), J. D. LYDEN, C. L. LISKOW, R. A. SHUCHMAN (Michigan, Environmental Research Institute, Ann Arbor, MI), and R. T. LOWRY (Intera Environmental Consultants, Ltd., Ottawa, Canada) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 1109-1116. refs (Contract N00014-81-C-0295)

An SAR model has been produced which successfully predicts gain compression effects in SAR images. It is shown that the real aperture of an SAR is significant in the SAR imaging process when the radar and/or recording system response is nonlinear, and that predicted radar-produced image artifacts caused by nonlinear operation are present in real imagery with the expected magnitudes. A nonlinear SAR amplitude response not only compresses the mean brightness of image features, but also creates images texture features at the boundaries of contrasting targets. Bright target proximity effects are significant for both point and distributed targets. A real sea ice image is studied and found to contain gain compression artifacts. These effects are quantified and found to agree within + or -2 dB with the model predictions. C.D.

**A85-10267#****OBSERVATIONS OF INTERNAL WAVES AND FRONTAL BOUNDARIES ON SEASAT SAR IMAGERY COLLECTED OVER THE EASTERN NORTH ATLANTIC OCEAN**

E. S. KASISCHKE (Michigan, Environmental Research Institute, Ann Arbor, MI), Y. C. TSENG, G. A. MEADOWS (Michigan, University, Ann Arbor, MI), and A. K. LIU (Dynamics Technology, Inc., Torrance, CA) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 1193-1212. refs (Contract N00014-81-C-2254; N00014-82-C-2308; N00014-81-C-0692)

**A85-10283#****REMOTE SENSING OF TEMPERATE AND TROPICAL INTERTIDAL ZONES USING SPOT SIMULATED DATA**

L. LOUBERSAC (Centre National pour l'Exploitation des Oceans, Centre Oceanologique de Bretagne, Brest, France) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 1363-1371. refs

Intertidal zone observations with remote sensing needs high resolution and repetitivity. A methodology based upon the processing of simulated SPOT data was developed. The

methodology first consists in separating the main targets one from another on the original image by the use of simple algorithms, in order to reduce the original variance; and then, in applying statistical classification algorithms upon the pixels clouds corresponding to zones of interest. Two examples, one upon seaweeds observation (temperate) and one upon mangroves observation (tropical) are given. Author

**A85-11191\*** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**TEMPORAL VARIABILITY OF THE ANTARCTIC CIRCUMPOLAR CURRENT OBSERVED FROM SATELLITE ALTIMETRY**

L.-L. FU (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) and D. B. CHELTON (Oregon State University, Corvallis, OR) Science (ISSN 0036-8075), vol. 226, Oct. 19, 1984, p. 343-346. NASA-supported research. refs

Sea level measurements by the Seasat altimeter were used to study the temporal variability of the Antarctic Circumpolar Current between July and October 1978. Large-scale zonal coherence in the cross-stream sea level difference was observed, indicating a general increase in the surface geostrophic velocity of the current around the Southern Ocean. The result demonstrates the power of satellite altimetry to monitor the variability of large-scale ocean currents. Author

**A85-11221****SLAR AND IN SITU OBSERVATIONS OF OCEAN SWELL MODIFICATION BY CURRENTS AND BATHYMETRY AT THE COLUMBIA RIVER ENTRANCE**

F. I. GONZALEZ (NOAA, Pacific Marine Environmental Laboratory, Seattle, WA) and C. L. ROSENFELD (Oregon State University, Corvallis, OR) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-22, Nov. 1984, p. 598-602. NOAA-supported research. refs

**A85-11222****IMPROVEMENT IN THE ESTIMATION OF DOMINANT WAVENUMBER AND DIRECTION FROM SPACEBORNE SAR IMAGE SPECTRA WHEN CORRECTED FOR OCEAN SURFACE MOVEMENT**

F. MONALDO (Johns Hopkins University, Laurel, MD) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-22, Nov. 1984, p. 603-608. refs (Contract N00024-83-C-5384)

**A85-11223****ESTIMATION OF OCEAN WAVE WAVENUMBER AND PROPAGATION DIRECTION FROM LIMITED SYNTHETIC APERTURE RADAR DATA**

G. E. CARLSON (Missouri-Rolla, University, Rolla, MO) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-22, Nov. 1984, p. 609-614. Navy-supported research. refs

A method for estimating wavenumber and propagation direction for the dominant wave component in an ocean wave field from a few scans of synthetic aperture radar data is described and analyzed. The use of just a few radar scans rather than a complete image reduces data storage requirements significantly. The analysis shown uses actual synthetic aperture radar data and provides parameter tradeoffs and statistical performance results. While reasonable estimates of wavenumber and propagation direction are achieved in some cases, the estimates are not sufficiently consistent to be satisfactory over a wide range of cases. The primary problem is one of low signal-to-noise ratio of the radar scan data. Author

**A85-11225****MINIMIZATION OF ATMOSPHERIC WATER VAPOR AND SURFACE EMITTANCE EFFECTS ON REMOTELY SENSED SEA-SURFACE TEMPERATURES**

C. ULIVIERI (Roma, Universita, Rome, Italy) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-22, Nov. 1984, p. 622-626. refs

## 05 OCEANOGRAPHY AND MARINE RESOURCES

**A85-11226\*** Research Triangle Inst., Hampton, Va.  
**ERRORS IN RADIOMETRIC REMOTE SENSING OF SEA-SURFACE TEMPERATURE AND SALINITY**  
C. L. BRITT, JR. (Research Triangle Institute, Hampton, VA) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-22, Nov. 1984, p. 627-632.  
(Contract NAS1-15338)

Techniques for remote measurement of sea-surface physical temperature and salinity using radiometric measurements from aircraft or satellite are reviewed. Studies have been conducted to determine the sensitivity of the errors in surface temperature and salinity to errors in the measured brightness temperatures using combinations of UHF, L, S, and C-band measurements. These investigations were made using values of conductivity, static dielectric constant, and relaxation time derived from the regression equations of Klein and Swift (1977). Results of the error sensitivity study are presented in the form of error contour plots which permit the calculation of errors in the estimation of the physical parameters for given errors in the raw radiometric measurements. Author

**A85-11573**  
**PROBLEMS ENCOUNTERED IN REMOTE SENSING OF LAND AND OCEAN SURFACE FEATURES**

M. J. DUGGIN (New York, State University, Syracuse, NY) and R. W. SAUNDERS (ESA, Darmstadt, West Germany) IN: Satellite sensing of a cloudy atmosphere: Observing the third planet London, Taylor and Francis, 1984, p. 241-287. refs

An examination is conducted of the physical principles controlling data recording by satellite sensors and of the analytical procedures employed in the study of surface features. Unresolved cloud and haze can strongly affect the accuracy of land feature mapping and of retrieved sea surface temperatures. Methods for the screening of cloud-affected data, as well as current research efforts toward the removal of the systematic part of this error source and the estimation of the effects of random error on target discrimination and quantification, are noted. O.C.

**A85-12052**  
**SPECIAL COLOUR ENHANCEMENT FOR THREE CHANNELS HAVING SIMILAR RADIANCES**

I. L. THOMAS and J. V. NICHOLAS (Department of Scientific and Industrial Research, Physics and Engineering Laboratory, Lower Hutt, New Zealand) International Journal of Remote Sensing (ISSN 0143-1161), vol. 5, Sept.-Oct. 1984, p. 753-760. Research supported by the New Zealand Antarctic Division, Department of Lands and Survey of New Zealand, and NSF. refs

The enhancement algorithm presently derived colors separate ground cover classes which, while having similar recorded wavelength distributions, have significantly varying intensities. The special enhancement function is derived from consideration of the spectrum locus of a chromaticity diagram and stretches the radiances to maximize color differences between ground cover classes. Designated the 'Sinusoidal Squeeze' algorithm, this method has been applied to the enhancement of Antarctic ice types recorded by Landsat. Field checks conducted during the 1980-1981 Antarctic summer field season confirm the capacity to delineate up to seven ice types. Forest class differentiations and bathymetric feature delineations are prospective applications of the algorithm. O.C.

**A85-12541#**  
**THE ERS-1 ACTIVE MICROWAVE INSTRUMENTATION**

G. DIETERLE (ESA, Earth Observation Programmes Dept., Noordwijk, Netherlands) IN: International Conference on Space, 24th, Rome, Italy, March 22, 23, 1984, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1984, p. 69-76.

The main element of the ERS-1 payload is the active microwave instrumentation, providing for three modes of operation: all-weather finite-resolution SAR imaging; measurement of the directional wave spectrum of the ocean; and measurement of the wind field over the ocean. The technical performance, the measurement principles,

and some applications of the active microwave instrumentation are described. L.M.

**A85-12545#**  
**REMOTE SENSING OF OCEAN DYNAMICS BY SATELLITE ALTIMETRY**

F. S. RUBERTONE and R. SOMMA (Selenia S.p.A., Rome, Italy) IN: International Conference on Space, 24th, Rome, Italy, March 22, 23, 1984, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1984, p. 113-122. refs

The main concepts on which the ERS-1 Radar Altimeter is based are described. Particular attention is given to the return-echo model; a system description and the main system parameters of the altimeter; a technique for the parameter estimation of the ERS-1 Radar Altimeter; and the use of the Radar Altimeter over continental ice. L.M.

**A85-12546#**  
**DETERMINATION OF THERMAL FLOW STRUCTURES IN THE IRMINGER STREAM (SE-GREENLAND) BY MEANS OF INFRARED SATELLITE DATA, AND THEIR RELATION TO THE SUBMARINE GEOMORPHOLOGY OF THE IRMINGER SHELF FOR THE BENEFIT OF DEEP-SEA FISHERY**

H. KAMINSKI (Institut fuer Umwelt- und Zukunftsforschung, Bochum, West Germany) IN: International Conference on Space, 24th, Rome, Italy, March 22, 23, 1984, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1984, p. 137-151. refs

**A85-12797\*** Naval Postgraduate School, Monterey, Calif.  
**THE POTENTIAL OF SATELLITE-BASED RADAR ALTIMETERS**

C. N. K. MOOERS (U.S. Naval Postgraduate School, Monterey, CA), D. E. BARRICK (Ocean Surface Research, Inc., Boulder, CO), R. E. CHENEY (NOAA, National Ocean Service, Rockville, MD), D. B. LAME (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA), and J. G. MARSH (NASA, Goddard Space Flight Center, Greenbelt, MD) EOS (ISSN 0096-3941), vol. 65, March 6, 1984, 6 p. NASA-sponsored research. refs

The benefits of satellite-based radar altimetry for oceanographic research are discussed in connection with the Seasat Altimeter Data Seminar. After a general review of the oceanographic data collected by the Seasat and GEOS-3 satellites, a number of criteria are proposed for the successful operation of a satellite-based radar altimeter for oceanographic remote sensing applications. It is shown how the interpretation of altimeter return power waveforms can be used to calculate wind speed, ocean circulation and variability in wind, waves, and tides. A number of recommendations for improving the accuracy of radar altimeter data are given which may be incorporated in the design of the GEOSAT and TOPEX research satellites. I.H.

**A85-13054#**  
**THE EXPERIMENTAL OCEANOGRAPHIC SATELLITE KOSMOS-1500**

IU. AFANASEV, B. A. NELEPO, A. S. SELIVANOV, B. E. KHMYROV, and V. P. SHESTOPALOV (Akademiia Nauk SSSR, Sovet Interkosmos, Moscow, USSR) International Astronautical Federation, International Astronautical Congress, 35th, Lausanne, Switzerland, Oct. 7-13, 1984. 9 p. refs  
(IAF PAPER 84-103)

The KOSMOS-1500 experiments will use side-looking 3.15 cm radar for below surface oceanographic studies, together with multichannel microwave radiometry and low resolution scanning over four optical band spectral intervals. Among the spacecraft's goals will be the surveying of Arctic Ocean ice fields to provide navigational data for northern sea routes' operations. O.C.

## A85-13055#

### DETERMINATION OF OCEANIC SURFACE STRUCTURE WITH 'COSMOS-1500' SATELLITE SIDE LOOKING RADAR

A. I. KALMYKOV, V. B. EFIMOV, V. I. ZELDIS, Y. V. ZONOV, A. S. KUREKIN, A. P. PICHUGIN, S. I. POTAICHUK, A. B. FETISOV, V. N. TSYMBAL, and V. P. SHESTOPALOV (Akademiia Nauk SSSR, Sovet Interkosmos, Moscow, USSR) International Astronautical Federation, International Astronautical Congress, 35th, Lausanne, Switzerland, Oct. 7-13, 1984. 33 p. refs (IAF PAPER 84-103A)

Oceanic surface studies conducted from space have generally been based on the employment of instruments utilizing the optical band. Unfortunately, such instruments cannot be used for studies in the polar regions during the arctic night. The present investigation is concerned with an employment of instrument utilizing radio waves. The physical basis of a study of the ocean by means of radar are considered along with the selection of parameters for the 'Cosmos-1500' side-looking satellite radar (SLSR) 'Cosmos-1500' SLSR parameters, and details of surface wind field determination with the aid of 'Cosmos-1500' SLSR. G.R.

## A85-13056#

### MONITORING OF THE ARCTIC AND ANTARCTIC ICE COVER WITH KOSMOS-1500 SATELLITE RADAR IMAGES

A. I. BURTSEV, A. I. KALMYKOV, L. M. MITNIK, M. NAZIROV, P. A. NIKITIN, A. P. PICHUGIN, and I. G. SPIRIDONOV (Gosudarstvennyi Nauchno-Issledovatel'skii Tsentr Izučeniia Prirodnykh Resursov, Moscow, USSR) International Astronautical Federation, International Astronautical Congress, 35th, Lausanne, Switzerland, Oct. 7-13, 1984. 12 p. refs (IAF PAPER 84-104)

## A85-13057#

### OCEAN RESEARCH FROM SPACE IN A VISIBLE SPECTRAL BAND

B. A. NELEPO, G. A. GRISHIN, and V. S. SUETIN (Akademiia Nauk Ukrainskoi SSR, Morskoi Gidrofizicheskii Institut, Sevastopol, Ukrainian SSR) International Astronautical Federation, International Astronautical Congress, 35th, Lausanne, Switzerland, Oct. 7-13, 1984. 7 p. refs (IAF PAPER 84-105)

Instrumental and data analysis techniques being employed in Soviet ocean monitoring activities from space are described. Visible and IR photographs are taken by cosmonauts using the MK-6M camera. Colored and B/W photographs taken from the Salyut space station have revealed internal ocean waves, possibly revealing stratification in the ocean. The observations have been correlated with surface ship soundings of solitons, which have been associated with thermoclines. In other programs, Meteor-30 visible images have traced sea surface salinities, particularly at river mouths, showing the eastward displacement of discharged river waters. The Kosmos 1151 and Interkosmos-21 spacecraft measured global water color variations with 10 km resolution. Account was taken of the atmospheric scattering of the upwelling microwave radiation. Further simulations have permitted corrections in ocean color scanning to track phytoplankton field growth and migration. M.S.K.

## A85-13058#

### APPLICATION OF INTERFERENCE METHOD IN INVESTIGATION OF PETROLEUM POLLUTION OF THE WORLD OCEAN WITH AEROSPACE FACILITIES

T. I. SHEVELEVA and M. A. RAKOV (Akademiia Nauk Ukrainskoi SSR, Fiziko-Mekhanicheskii Institut, Kharkov, Ukrainian SSR) International Astronautical Federation, International Astronautical Congress, 35th, Lausanne, Switzerland, Oct. 7-13, 1984. 6 p. refs (IAF PAPER 84-106)

The results of tests run in a shoal region where repetitive occurrences of oil slicks occur to compare thicknesses of the film with laser fluorescence data from an aircraft are reported. A He-Ne laser wavelength was used, and in situ measurements were taken at 5-20 points along and perpendicular to the wind vector. The

petroleum distribution was found to be controlled by the wind force and fetch, resulting in a truncated Gaussian distribution. Laser beam sounding of the surface was therefore modeled in terms of the reflectance and dispersion of the signal. An adaptive optics system was devised which automatically selects an optimized digitization process for a received signal by taking into account reference data on petroleum-reflected signals. M.S.K.

## A85-13059#

### COMPLEX STUDY OF THE ATMOSPHERIC AND OCEAN STATE BY DATA FROM THE SCIENTIFIC EQUIPMENT INSTALLED ON 'METEOR-PRIRODA' SATELLITE

D. N. MISHEV, V. S. PETROVA, G. IVANOV, A. KRUMOV, and T. NAZARSKI (B'lgarska Akademiia na Naukite, Tsentralna Laboratoriia za Kosmicheski Izsledvaniia, Sofia, Bulgaria) International Astronautical Federation, International Astronautical Congress, 35th, Lausanne, Switzerland, Oct. 7-13, 1984. 7 p. refs (IAF PAPER 84-108)

The ability of the complex measuring equipment developed by the BULGARIA-1300-II project to study the state of the atmosphere and ocean is examined. The project is intended to determine the optical parameters of the atmosphere and register its influence by satellite data measurements in 32 spectral ranges in the 0.450-0.900 micron interval. The project will determine the temperature of the ocean, the atmospheric parameters, and the cloudiness by measuring the self-radiance in four characteristic wavelengths. Joint measurements in the radio, microwave, and optical regions of the spectrum will provide enhanced reportage of data as well as increase the range of tasks solved and the accuracy and reliability of the results. C.D.

## A85-13060#

### DYNAMICAL INTERACTION OF OCEAN AIR HEAT FLUX ESTIMATED BY SATELLITE TO THE OUTBURST OF COLD AIR

L.-C. CHIEN (Academia Sinica, Institute of Physics, Taipei, Republic of China) and W.-S. HO (Yungta College of Technology, Pingtung; Academia Sinica, Institute of Physics, Taipei, Republic of China) International Astronautical Federation, International Astronautical Congress, 35th, Lausanne, Switzerland, Oct. 7-13, 1984. 14 p. Sponsorship: National Science Council of the Republic of China. refs (Contract NSC-73-0202-M001-10) (IAF PAPER 84-109)

A numerical model for obtaining clear column upwelling thermal radiance using satellite sensors is presented, including a water vapor correction. Attention is focused on the AVHRR scanner on the NOAA-7 spacecraft, and in particular the 3.7 and 11 microns sensors for sea surface temperature measurements and the 12 microns channel for vapor correction. A four level primitive equations formulation covers the momentum, thermodynamics, specific humidity and continuity. Account is taken of hydrostatic conditions, forcing mechanisms, friction, diabatic heating, cloud free regions, and boundary conditions. A finite difference method is used to solve the primitive equations, and a fourth order explicit Runge-Kutta-Gill scheme integrates the prognostic equations. A comparison made between data and predictions for a cold air outbreak over east Asia demonstrates that accurate 24 hr geopotential and temperature field predictions are available with the model. M.S.K.



## 05 OCEANOGRAPHY AND MARINE RESOURCES

**A85-13061#**

### **THE MKS-M REMOTE SENSING EXPERIMENT FOR DETERMINATION OF OCEAN AND ATMOSPHERIC PARAMETERS FROM SALYUT-7**

G. ZIMMERMANN, B. PIESIK (Deutsche Akademie der Wissenschaften, Institut fuer Kosmosforschung, Berlin, East Germany), W. W. BADAIEV, and M. S. MALKEVICH (Akademiia Nauk SSSR, Institut Kosmicheskikh Issledovaniy, Moscow, USSR) International Astronautical Federation, International Astronautical Congress, 35th, Lausanne, Switzerland, Oct. 7-13, 1984. 8 p. refs (IAF PAPER 84-110)

The MKS-M experiment continued the remote sensing investigations of the atmosphere-ocean system made on board the satellites 'Intercosmos-20' and '-21' /1/. The main goal of the experiment was to get complex data on the radiation characteristic of the atmosphere-ocean system to develop algorithms for the determination of the 'state' of the ocean (in particular its bioproductivity) based on remote measurements. Corresponding to this goal complex measurements have been made on board 'Salyut-7' with an 18 channel modified spectrometer device MKS-M and the multispectral camera MKF-6M, supported by color photos, visual observations and measurements on aircraft and research vessels. A complex concept for the analysis of the MKS-M data is described. The results of tests of the corresponding algorithm and some data for water reflectance are given. Author

**A85-13062#**

### **CONCEPT OF AN ADVANCED OPTICAL OCEAN COLOUR MONITORING INSTRUMENT WITH SELF-SCANNING DETECTOR ARRAYS**

B. KUNKEL (Messerschmitt-Boelkow-Blohm GmbH, Ottobrunn, West Germany), M. CUTTER (Sira, Ltd., Chislehurst, Kent, England), and E. OMONGAIN (University College, Dublin, Ireland) International Astronautical Federation, International Astronautical Congress, 35th, Lausanne, Switzerland, Oct. 7-13, 1984. 13 p. refs (IAF PAPER 84-111)

A concept of a modular opto-electronical scanner based on CCD type linear detector arrays in 8 visible/NIR and 5 IR spectral channels is presented with separate optics per channel. The instrument is conceived for rather stringent measurement requirements which are briefly discussed, especially in terms of spectral resolution and fidelity as well as dynamic range. The remaining critical areas and development needs are identified and discussed. Author

**A85-13064#**

### **THE ADVANCED OCM - AN IMAGING SPECTROMETER FOR THE MAPPING OF SEA-SURFACE CHLOROPHYLL CONTENT**

G. CERUTTI-MAORI (Societe Nationale Industrielle Aerospatiale, Cannes, France) International Astronautical Federation, International Astronautical Congress, 35th, Lausanne, Switzerland, Oct. 7-13, 1984. 11 p. (IAF PAPER 84-114)

Design features of the ocean color monitoring (OCM) 8-channel multispectral remote sensing instrument intended for launch with the ERS2 satellite in the early 1990s are outlined. The OCM is being built for monitoring the sea surface chlorophyll content with a 20 percent accuracy. The push-broom mode scan will cover a 32 deg FOV in terms of 8 deg elementary fields sensing yellow materials, chlorophyll, chlorophyll/turbidity, turbidity, chlorophyll fluorescence, and atmospheric correction data. Images with 110,592 pixels will be generated while the ERS2 moves in a 777 km descending heliosynchronous orbit. Details of all system components are provided, noting the instrument's capability of scanning land, as well as sea, images and adjusting the spectral bands scanned in response to ground commands. M.S.K.

**A85-14445**

### **SYNTHETIC APERTURE RADAR PROCESSING USING A VAX 11/780 AND FPS-164 ATTACHED PROCESSOR**

B. E. RAFF and J. L. KERR (Johns Hopkins University, Laurel, MD) IN: EASCON '83; Proceedings of the Sixteenth Annual Electronics and Aerospace Conference and Exposition, Washington, DC, September 19-21, 1983. New York, Institute of Electrical and Electronics Engineers, 1983, p. 159-164. (Contract N00024-83-C-5301)

The Johns Hopkins University Applied Physics Laboratory has developed a synthetic aperture radar (SAR) processor for oceanographic applications. The processor was implemented on a VAX 11/780 host computer with an FPS-164 attached processor, and was designed to maximize use of the FPS-164 computational power, large memory capacity, and associated disks. Care was taken to develop source code in easily adaptable modules for SARs of different characteristics. This paper presents the basic SAR processing functions and their implementation on the FPS-164. Author

**A85-15176**

### **EVALUATION OF GMS-DERIVED SEA SURFACE TEMPERATURE IN THE SOUTHERN HEMISPHERE**

K. ABE (Japan Meteorological Agency, Meteorological Satellite Center, Tokyo, Japan; Bureau of Meteorology, Melbourne, Australia) Australian Meteorological Magazine (ISSN 0004-9743), vol. 32, June 1984, p. 55-74. refs

A general description of the Japanese Geostationary Meteorological Satellite (GMS) ten-day mean sea surface temperature (SST) is briefly given, and the seasonal evaluation of the products using a drifting buoy and conventional ship observations around Australia during 1979 and 1980 is described. A standard ten-day mean SST is reported and the acquisition rates and accuracy of the GMS SST are addressed. Seasonal geographic distribution patterns of GMS SST data acceptance/rejection fields for 1979 and 1980 are presented. C.D.

**A85-15418**

### **GENESIS AND EFFECTS OF LONG WAVES IN THE EQUATORIAL PACIFIC**

D. V. HANSEN (NOAA, Atlantic Oceanographic and Meteorological Laboratory, Miami, FL) and C. A. PAUL (Cooperative Institute for Marine and Atmospheric Studies, Coral Gables, FL) Journal of Geophysical Research (ISSN 0148-0027), vol. 89, Nov. 20, 1984, p. 10,431-10,440. refs

Data from 20 satellite-tracked drifting buoys deployed in the eastern equatorial Pacific Ocean during the summer of 1979 were used to investigate the nature, effects, and energetics of currents associated with cusp-shaped long waves observed in satellite IR imagery of the sea surface during all except El Nino years. It is shown that the long waves are associated with a vigorous pattern of mesoscale eddies lying primarily between the equator and 7 deg N. The spatial structure of the eddy kinetic energy closely resembles the eigenfunctions obtained from Philander's (1978) investigation of barotropic instability of that part of the South Equatorial Current lying north of the equator. Computation of the energy exchange between the eddies and the mean field suggests an e folding time of about two weeks for the eddies and a braking effect on the mean flow comparable to a change of surface wind stress of a few tenths of a dyne per square centimeter. The eddies also effect an equatorward transport of heat that amounts to about two thirds of the poleward heat transport of the divergent Ekman transport in the near-surface waters. Author



A85-15421

**A THEORY OF THE IMAGING MECHANISM OF UNDERWATER BOTTOM TOPOGRAPHY BY REAL AND SYNTHETIC APERTURE RADAR**

W. ALPERS (Hamburg, Universitaet, Max-Planck-Institut fuer Meteorologie, Hamburg, West Germany) and I. HENNINGS (Hamburg, Universitaet, Hamburg, West Germany) *Journal of Geophysical Research* (ISSN 0148-0027), vol. 89, Nov. 20, 1984, p. 10,529-10,546. Sponsorship: Deutsche Forschungsgemeinschaft. refs  
(Contract DFG-SFB-94)

One of the great surprises of the Seasat mission in 1978 is related to the recognition that underwater topographic features down to a depth of tens of meters below the ocean surface can be detected by synthetic aperture radar (SAR). The present investigation has the objective to present a simple imaging model which is capable of explaining basic features observed in radar imagery of subsurface bottom topography. This model uses the continuity equation for flow normal to the subsurface barrier to describe the bathymetry-current interaction, and uses the weak hydrodynamic interaction theory in the relaxation time approximation to describe the current-wave interaction. The crucial aspect of the considered theory is related to the recognition that the approximation previously applied to the radiation balance equation is not valid in this case. G.R.

A85-15422

**ISLAND WAKES IN SHALLOW COASTAL WATERS**

E. WOLANSKI (Australian Institute of Marine Science, Townsville, Queensland, Australia), J. IMBERGER (Western Australia, University, Nedlands, Australia), and M. L. HERON (North Queensland, University, Townsville, Australia) *Journal of Geophysical Research* (ISSN 0148-0027), vol. 89, Nov. 20, 1984, p. 10,553-10,569. Research supported by the Australian Institute of Marine Science, Centre for Environmental Fluid Dynamics, and University of North Queensland. refs

Developments related to an understanding of the details of the flows in the wake of headlands and islands are considered. The lack of knowledge regarding eddies shed by headlands led to a detailed field study of the circulation around Rattray Island, northeast Australia. The site was selected because the waters are turbid, enabling aerial observation of turbidity patterns, and because the physical scales yield values for the ratio of depth to island width and Reynolds number which are typical of coastal waters. The results of the study are discussed, taking into account tides, Landsat imagery, aerial photography, the temperature field, currents, and the sediment. It is found that large eddies form behind the island. The evolution of the eddies is rapid, and the decay on the turning tide is also rapid enough to avoid strong momentum effects. G.R.

A85-15425\* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**SPATIAL VARIATION OF SEA SURFACE TEMPERATURE AND FLUX-RELATED PARAMETERS MEASURED FROM AIRCRAFT IN THE JASIN EXPERIMENT**

W. T. LIU (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) and K. B. KATSAROS (Washington, University, Seattle, WA) *Journal of Geophysical Research* (ISSN 0148-0027), vol. 89, Nov. 20, 1984, p. 10,641-10,644. NASA-supported research. refs  
(Contract N0014-80-C-0252)  
(AD-A149321)

Spatial variation of some parameters measured on two aircraft flying 100-km box and 200-km triangular patterns at low levels in the atmospheric boundary layer during the Joint Air Sea Interaction Experiment in the North Atlantic was studied. The variation should be representative of summer conditions in mid-latitude oceans. The variance density of remotely sensed sea surface temperature, corrected for sky reflection, is found to depend on the one-dimensional wave number raised to the power of approximately -5/3. Nonuniform clouds add low-frequency variance to observations of a downward looking radiometer and result in

steeper slope of the spectra of uncorrected sea surface temperature. Turbulent fluxes of momentum, sensible heat, and moisture were determined with the bulk formulae from the parameters (wind speed, temperature, specific humidity, and sea surface temperature) measured from the aircraft. The averages of these fluxes over each flight leg were compared with the fluxes determined from the parameters averaged over the same leg. The difference is negligible, showing that spatially averaged observations, such as those from spaceborne sensors, can be used in the bulk formulae to evaluate the fluxes. Author

A85-16538\* State Univ. of New York, Stony Brook.

**SATELLITE COLOR OBSERVATIONS OF THE PHYTOPLANKTON DISTRIBUTION IN THE EASTERN EQUATORIAL PACIFIC DURING THE 1982-1983 EL NINO**

G. FELDMAN (New York, State University, Stony Brook, NY), D. CLARK (NOAA, National Environmental Satellite, Data, and Information Service, Washington, DC), and D. HALPERN (NOAA, Pacific Marine Environmental Laboratory, Seattle, WA) *Science* (ISSN 0036-8075), vol. 226, Nov. 30, 1984, p. 1069-1071. NOAA-supported research. refs  
(Contract NGR-33-015-802)

Images provided by the Coastal Zone Color Scanner (CZCS) onboard Nimbus-7 show the effect of the 1982-1983 El Nino upon the phytoplankton distribution around the Galapagos Islands, located on the equator. The CZCS scenes document a major redistribution of phytoplankton around the Galapagos Island during a period when sea-surface temperatures (SST) were anomalously high (28 to 29 C). The mixed layer was unusually thick for this region, and the winds and both the surface and subsurface flows changed directions. It is pointed out that the El Nino is characterized as one of the most spectacular examples of a large-amplitude, interannual response of the ocean to atmospheric forcing. The 1982-1983 El Nino is the best documented event of its kind to date, and details of its effects are discussed. G.R.

A85-16583

**MEASUREMENT OF OCEAN SURFACE CURRENTS FROM SPACE WITH MULTIFREQUENCY MICROWAVE RADARS - A SYSTEM ANALYSIS**

R. E. MCINTOSH, C. T. SWIFT (Massachusetts, University, Amherst, MA), R. S. RAGHAVAN (Northeastern University, Boston, MA), and A. W. BALDWIN (Mitre Corp., Bedford, MA) *IEEE Transactions on Geoscience and Remote Sensing* (ISSN 0196-2892), vol. GE-23, Jan. 1985, p. 2-12. refs

The use of multifrequency microwave radars to measure ocean surface currents from satellites is considered in this paper. The effects that satellite motion, background backscatter from the ocean surface, and receiver noise have on the ability of such systems to obtain current maps are discussed. An example is presented which shows that radars in geostationary orbit have the potential to map ocean currents over large areas of the ocean surface. Author

A85-16886

**POTENTIAL FOR REMOTE SENSING IN OCEANOGRAPHIC RESEARCH AND MONITORING OF OIL POLLUTION [MOEGELICHKEITEN DER FERNERKUNDUNG FUER OZEANOGRAPHISCHE FORSCHUNG UND UEBERWACHUNG VON OELVERSCHMUTZUNGEN]**

K. RICHTER (Deutsches Hydrographisches Institut, Hamburg, West Germany) *Zeitschrift fuer Flugwissenschaften und Weltraumforschung* (ISSN 0342-068X), vol. 8, Sept.-Oct. 1984, p. 319-325. In German.

Remote sensing studies of oceanic ice, waves, and oil pollution are reviewed. Findings on the formation, growth, drift, and melting of ice in the Baltic Sea and of tidal bores, whirlpools, and wave formations in the Mediterranean Sea, Bay of Biscay, the North Sea, and the Bahamas area are addressed. Remote sensing observations of oil pollution in the English Channel and the Mediterranean Sea are discussed and possibilities for future oil pollution monitoring projects are considered. C.D.

## 05 OCEANOGRAPHY AND MARINE RESOURCES

**A85-16894**

**REPRESENTATION OF OCEANIC MOTIONS IN SATELLITE INFRARED AND RADAR ALTIMETER DATA [ZUR ABBILDUNG OZEANISCHER BEWEGUNGSVORGAENGE IN SATELLITENINFRAROT- UND RADARALTIMETERDATEN]**

P. G. HARDTKE (Kiel, Universitaet, Kiel, West Germany) Zeitschrift fuer Flugwissenschaften und Weltraumforschung (ISSN 0342-068X), vol. 8, Sept.-Oct. 1984, p. 359-364. In German. refs

The importance of satellite remote sensing in the infrared atmospheric windows for studying oceanic motions is addressed. The signal range in which these motions can be determined in future altimeter measurements is discussed. Methods of evaluating satellite data are described, and examples of surface temperature distributions in the North Atlantic obtained by remote sensing are presented. The correlation between film temperature, hydrographic ship measurements, and the movements of drift buoys as measured by satellite is discussed. C.D.

**A85-16940**

**EQUATORIAL WAVES IN THE FIELD OF OCEAN SURFACE TEMPERATURE ACCORDING TO SHIP AND SATELLITE MEASUREMENTS [EKVATORIAL'NYE VOLNY V POLE TEMPERATURY POVERKHNOSTI OKEANA PO DANNYM SUDOVYKH I SPUTNIKOVYKH IZMERENIY]**

A. S. KAZMIN, R. LEHECKIS, and K. N. FEDOROV (Akademiia Nauk SSSR, Institut Okeanologii, Moscow, USSR; NOAA, Washington, DC) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), Sept.-Oct. 1984, p. 3-7. In Russian. refs

Leheckis (1977) has reported an existence of long waves in the Eastern Equatorial Pacific Ocean on the basis of data obtained with the aid of a geostationary satellite. The present investigation is concerned with data which confirm these observations. These data are the result of direct measurements of the sea surface temperatures conducted during a voyage of a Soviet research vessel in January 1982. A thermistor, representing a temperature-sensitive resistor device, kept at a depth in the range from 0.15 to 0.20 m was employed for the determination of the sea temperatures. The accuracy of the measurements was 0.05 C. The measured sea surface temperatures were shown in a graph as a function of the position of the ship at the time of measurement. Temperature data obtained on the basis of satellite data (NOAA/NESS) are also represented in the graph. The obtained data provide information regarding the hydrophysical characteristics of the equatorial front for the Northern Hemisphere in winter. There is satisfactory agreement between the two differently derived types of temperature data. G.R.

**A85-17097#**

**MODELLING ICE-SHEET SURFACES FOR ERS-1'S RADAR ALTIMETER**

N. F. MCINTYRE (London, University College, Dorking, Surrey; Cambridge University, Cambridge, England) and D. J. DREWRY (Cambridge University, Cambridge, England) ESA Journal (ISSN 0379-2285), vol. 8, no. 3, 1984, p. 261-274. Sponsorship: European Space Agency and Natural Environment Research Council of England. refs

(Contract ESA-5182/82-F-CG(SC); NERC-GR/3/4462)

Features of an ice-sheet model developed in support of planned ERS-1 radar altimeter scans of Antarctic glacial formations are detailed. The scans will be used to improve the data base on ice sheet form and topography, transition zones and grounding lines, ice-sheet margins and mass balances. Dimensional scales of about 100 km for ice sheets and transient surface features and 10 km for dynamic surface topography will be used. An approximation has been defined for the surface profiles of the Antarctic ice sheet, based mainly on Seasat altimetry data. Corrections have been developed to account for near parabolic forms, cross-flow modifications for ice streams and outlet glaciers, the fringing ice shelf, and a vertical cliff 50 m high at the ice-shelf margin. Ice flow undulations are simulated as bell-shaped mounds and sastrugi and snow dunes by tent-shaped mounds. The studies are considered essential for monitoring possible catastrophic ice melts

which could occur if CO<sub>2</sub> atmospheric warming processes accelerate. M.S.K.

**A85-17424**

**LASER AIRBORNE REMOTE SENSING OF TURBIDITY PROFILES AND THE MAPPING OF PHYTOPLANKTON DISTRIBUTION [O LAZERNOM AEROZONDIROVANII PROFILIA MUTNOSTI I KARTIROVANII RASPREDELENIIA FITOPLANKTONA]**

A. F. BUNKIN, D. V. VLASOV, D. M. MIRKAMILOV, and V. P. SLOBODIANIN (Akademiia Nauk SSSR, Institut Obshchei Fiziki, Moscow, USSR) Akademiia Nauk SSSR, Doklady (ISSN 0002-3264), vol. 279, no. 2, 1984, p. 335-337. In Russian.

Results of the Chlorophyll-83 expedition have demonstrated the feasibility of the operational laser mapping of deep turbidity profiles, the distribution of dissolved organic substances (DOS), and the distribution of phytoplankton. It is shown that regular measurements of the 'instantaneous' structure of the three-dimensional fields of these parameters, and an analysis of their time variability and depth migration can be used to solve a number of practical problems, including the investigation of shelf currents, the migration of industrial pollutants, and the effect of pollution on organisms in the shelf zone. In addition, it is noted that the mapping of DOS distribution anomalies at various depths will aid in the exploration for petroleum deposits in the shelf zone. B.J.

**A85-17507**

**TRACKING OCEAN SURFACE WAVES USING SPACEBORNE SAR IMAGE SPECTRA CORRECTED FOR OCEAN SURFACE MOVEMENT**

F. MONALDO (Johns Hopkins University, Laurel, MD) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 6 p. refs

(Contract N00024-78-C-5384)

It is demonstrated in this paper that certain nonlinear aspects in the SAR wave imaging process caused by ocean surface motion can be treated as simple resolution losses in a linear system. Such an approach explains the falloff in response at high azimuth wavenumber experienced in SAR image spectra during high sea states and allows for the alleviation of this problem in SAR spectra. It is shown that when such techniques are employed, they result in Seasat SAR image spectra in which the positions of spectral peaks are more consistent with the estimated location of the storm sources that generated those waves. Author

**A85-17508**

**ESTIMATION OF OCEAN WAVE WAVENUMBER AND PROPAGATION DIRECTION FROM LIMITED SYNTHETIC APERTURE RADAR DATA**

G. E. CARLSON (Missouri-Rolla, University, Rolla, MI) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 6 p. Navy-supported research.

A method for determining wavenumber and propagation direction for the dominant wave component in an ocean wave field from a few scans of synthetic aperture radar data is described and analyzed. The analysis uses actual synthetic aperture radar data and provides parameter tradeoffs and statistical performance results. While reasonable estimates of wavenumber and propagation direction are achieved in some cases, the estimates are not sufficiently consistent to be satisfactory over a wide range of cases. The primary problem is one of low signal-to-noise ratio of the radar scan data. Author

A85-17509

**INVESTIGATION OF GULF STREAM RING DETECTION WITH SPACEBORNE ALTIMETER USING MEAN SEA HEIGHT, WAVE HEIGHT AND RADAR CROSS SECTION**

E. DOBSON and D. IRVINE (Johns Hopkins University, Laurel, MD) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 7 p. refs

A85-17512

**REMOTE SENSING OF THE DIRECTIONAL OCEAN WAVE SPECTRA USING HF BACKSCATTER RADAR**

A.-R. ELABDALLA (Yarmouk University, Irbid, Jordan) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 6 p. refs

The use of superresolution spectrum estimation techniques in the remote sensing of the wave-height directional ocean wave spectrum (DOWS) with HF backscatter radar is discussed. In particular, the following techniques are compared: multiple signal classification (MUSIC), maximum entropy (ME), and maximum likelihood (ML). Of the three approaches evaluated, MUSIC is shown to provide the closest estimate when compared with buoy and SAR data. V.L.

A85-17524

**GOES TRANSMISSION OF OCEAN TEMPERATURE AND WEATHER DATA FROM A NORTH ATLANTIC SHIP-OF-OPPORTUNITY**

S. E. MCDOWELL and D. L. DORSON (Bathy Systems, Inc., West Kingston, RI) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 4 p.

Bathy Systems, Inc. has developed a complete system for shipboard acquisition of ocean temperature and meteorological data. Ocean temperature profiles to a depth of 2000 meters can be obtained using expendable bathythermograph (XBT) probes while the ship is underway. Routine ship's weather observations can be entered into the system by the observer. Coded XBT and weather messages are stored in a satellite transitter which sends the data to the shore-based NOAA/NESS computer facility in Maryland. Within minutes after transmission from the ship, these data are available for environmental analysis by NOAA, NWS, FNO and researchers having access to the NOAA/NESS data stream. Author

A85-17542\* Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.

**THE POTENTIAL OF SAR DIRECTIONAL SPECTRA IN OPERATIONAL WAVE FORECASTING**

R. C. BEAL, T. W. GERLING, and D. E. IRVINE (Johns Hopkins University, Applied Research Laboratory, Laurel, MD) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 6 p. NASA-Navy-supported research. refs

Digitally processed Seasat SAR ocean wave imagery, when digitally transformed, smoothed, and corrected for known instrument biases, can accurately track multiple (at least three) wave systems in the open ocean, across major currents, and into shallow water. Furthermore, the relative backscatterer of the digitally processed SAR image, when sampled within a single pass and along a constant range, responds to the local wind through a simple power law relationship. The results indicate that SAR spectra, if obtained from a low altitude satellite, could be an important supplement to global winds and non-directional wave heights obtained through other methods. Author

A85-17544

**TRANSFORMATION OF WAVE SPECTRA AT A TIDAL INLET**

F. I. GONZALEZ (NOAA, Pacific Marine Environmental Laboratory, Seattle, WA) and C. L. ROSENFELD (Oregon State University, Corvallis, OR) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 7 p.

In-situ and SLAR ocean wave observations offshore and at the entrance of the Columbia River have been acquired during slack tide and during a peak ebb period when the current speed was estimated to be in excess of 2 m/s. Two dominant swell systems characterized the offshore wave spectra, a long (300-400 m) system propagating due east and a shorter (150-200 m) system propagating north by northeast. On the ebb, the longer wave system was amplified at the entrance by a factor of 1.6, in contrast to the shorter system which underwent little or no increase in wave height. This selective modification is interpreted in terms of linear wave-current-bathymetry interaction. In the case of the longer system, shoaling and single opposition by a current should have produced an amplification of only 1.3; it is concluded that the observed enhanced amplification of 1.6 is attributable to bathymetric and current refraction. In the case of the shorter system, the absence of any amplification is attributed to the fact that the observed incidence angle of the waves was approximately 50 deg off the main axis of the current. Author

A85-17575

**SYSTEM DESIGN AND PERFORMANCE OF ERS-1**

U. B. PICKER and H. M. BRAUN (Dornier System GmbH, Friedrichshafen, West Germany) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 6 p.

The design and mission objectives of ERS-1, a terrestrial-remote-sensing satellite being developed by ESA for Ariane launch to a 777-km 98.5-deg orbit, are reviewed, and the performance of the major payload components is predicted. The ERS-1 system aims to provide ocean wind-vector fields; wave spectra; significant-wave-height (SWH) measurements; SAR imaging of ocean, ice, and land areas; and mean-spacecraft-altitude data to both scientific and commercial users. The instruments, platform, telemetry and telecommand links, real-time data-transmission downlinks, ground segment, mission phases, and performance-evaluation system are characterized and illustrated with drawings, tables, and diagrams. Performance predictions are given for the SAR imaging mode (resolution 30-100 m, image size 8C x 80 km, and radiometric resolution 1-2.5 dB), the SAR wave mode (resolution less than 30 m for a 5 x 5-km image), the scatterometer (random-gain error less than 0.35 dB, opposite-gain bias less than 0.5 dB, and same-sense-gain bias depending on the development of improved calibration techniques and/or an ERS-1-matched wind model), and the radar altimeter (SWH accuracy 8.6 percent, time-delay accuracy 320 ps for SWH 4 m and 660 psec for SWH 16 m, and power accuracy 0.5 dB for sigma-zero 8 dB and 1 dB for sigma-zero 20 dB). T.K.

A85-17577\* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**COASTAL ZONE COLOR SCANNER DATA OF RICH COASTAL WATERS**

R. C. WRIGLEY (NASA, Ames Research Center, Moffett Field, CA) and S. A. KLOOSTER (Sensible Research, Palo Alto, CA) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 5 p. refs

Comparisons of chlorophyll concentrations and diffuse attenuation coefficients measured from ships off the central California coast were made with satellite derived estimates of the same parameters using data from the Coastal Zone Color Scanner. Very high chlorophyll concentrations were encountered in Monterey

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Bay. Although lower chlorophyll values acquired off Pt. Sur agreed satisfactorily with the satellite data, the high chlorophyll values departed markedly from agreement. Two possible causes for the disagreement are suggested. Comparison of diffuse attenuation coefficients from the same data sets showed closer agreement.

Author

### A85-17579

#### EXPERIMENTAL RESULTS FROM OIL THICKNESS MEASUREMENTS WITH THE MICROPROCESSOR CONTROLLED MICROWAVE RADIOMETER

A. LAAPERI (Helsinki University of Technology, Espoo, Finland) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 5 p. refs

Experimental results with an airborne microwave radiometer system from the oil slick experiment carried out in Norway in July 1982 are presented. The extraordinary correlation between the two measuring frequencies are discussed, and computer simulations and laboratory measurements with oil and water emulsion have been performed to be able to explain the behavior of the curves.

Author

A85-17580\* Environmental Research Inst. of Michigan, Ann Arbor.

#### MODELING OF BOTTOM-RELATED SURFACE PATTERNS IMAGED BY SYNTHETIC APERTURE RADAR

D. R. LYZENGA, R. A. SHUCHMAN, E. S. KASISCHKE (Michigan, Environmental Research Institute, Ann Arbor, MI), and G. A. MEADOWS (Michigan, University, Ann Arbor, MI) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 10 p. NASA-supported research. refs (Contract N00014-81-C-2254; N00014-81-C-0692; NOAA-MO-A01-78-00-4339)

A hydrodynamic electromagnetic model is developed in order to provide a qualitative and quantitative description of the relationship between Seasat synthetic aperture radar (SAR) signatures and the bottom topography of the ocean in the English Channel region of the North Sea. The model is based on environmental data for winds, currents, and depth changes, and the SAR parameters of frequency polarization, incidence angle, and resolution cell size. The data are used as inputs and SAR backscatter changes are predicted for individual topographic changes on the ocean floor. It is found that the model estimates of backscatter values are in good agreement with actual Seasat SAR-observed backscatter values. A comparison of the model and actual data shows agreement to be within 1.5 dB. The model is considered to be valid for only shallow water areas (less than 50 meters in depth). It is suggested that for bottom features to be visible on SAR imagery at greater depths, a moderate-to-high velocity current of at least 0.4 m/s and a moderate wind no more than 7.5 m/sec must be present.

I.H.

### A85-17586

#### PASSIVE REMOTE SENSING OF THE OCEAN

R. L. BERNSTEIN (California, University, La Jolla, CA) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 3 p. refs

A new generation of radiometers, operating in the microwave, visible, and infrared portions of the spectrum, is now providing measurements of ocean surface temperature, color, and wind. Demonstrated accuracies are now sufficient for addressing many practical and research applications. Advancement in accuracy beyond the present state of the art will most likely result from methods for simultaneously combining measurements from the various sensors.

Author

### A85-17589

#### A SCATTEROMETER FOR WIND FIELD DETECTION ON THE OCEAN SURFACE

P. HANS (Dornier System GmbH, Friedrichshafen, West Germany) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 5 p.

Two alternative scatterometer system concepts for the ESA Remote Sensing Satellite (ERS-1) have been established and analyzed using performance simulators. Of the two concepts, i.e., dual beam/dual polarization and three-beam/single polarization, the latter has been selected as the preferable system configuration. For the selected system concept, detailed Monte Carlo simulations have been performed to provide error statistics for computed wind speeds and directions as a function of error budgets, depending on different system design parameters. As a result, a final set of optimized parameters has been established for the ERS-1 Scatterometer.

V.L.

### A85-17762

#### THE DETECTION OF INTERNAL WAVES IN THE NORTH ATLANTIC USING REAL APERTURE AIRBORNE RADAR

M. BAGG (Admiralty Research Establishment, Ocean Science Div., Portland, Dorset, England) and J. O. THOMAS (Imperial College of Science and Technology, London, England) International Journal of Remote Sensing (ISSN 0143-1161), vol. 5, Nov.-Dec. 1984, p. 969-974. refs

Imaging radars on aircraft and satellites provide a basis for monitoring some important properties of the deep interior of the ocean through an analysis of the surface signatures of internal waves. It is pointed out that the presence of internal waves disturbs the position of the thermocline and, therefore, affects acoustic sound channels in the sea. Such effects have important consequences for sonic underwater communications and military surveillance. The use of remote sensing techniques to reveal the presence and structure of the cell pattern of internal waves is, thus, potentially capable of making a valuable contribution to an understanding of internal wave formation. The present investigation is concerned with the preliminary results of an air search for internal wave surface signatures in the North Atlantic using a real aperture radar. The considered survey shows that, for use with aircraft, a real aperture radar provides an excellent technique for recording the surface signatures of internal waves.

G.R.

### A85-18014

#### INSOLATION DURING STREX. I - COMPARISONS BETWEEN SURFACE MEASUREMENTS AND SATELLITE ESTIMATES

C. GAUTIER (California, University, La Jolla, CA) and K. B. KATSAROS (Washington, University, Seattle, WA) Journal of Geophysical Research (ISSN 0148-0227), vol. 89, Dec. 20, 1984, p. 11779-11788. refs (Contract NSF ATM-82-05817; NSF ATM-80-17069; NOAA-NA-81RAA00253)

One of the objectives of the Storm Transfer and Response Experiment (STREX) was to study the magnitudes and spatial scales of the fluxes occurring across the air-sea interface during cyclonic storms. An eventual goal was the development of a model of a 'composite' mid-latitude cyclone and the response of the upper ocean to its passage. STREX was conducted in November and December of 1980 in the northeastern part of the Pacific Ocean. Two ships, including the Canadian weather ship 'Vancouver' and the American research vessel 'Oceanographer', were employed in the studies. The present investigation has the objective to demonstrate the importance of the surface data for in situ validation of satellite measurements and algorithms. The satellite and in situ measurements also provide valuable redundancy checks, one for the other, and make it possible to close data gaps in the time series.

G.R.

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**A85-18463\*** Maryland Univ., College Park.

### **A FUNDAMENTAL MODEL AND EFFICIENT INFERENCE FOR SAR OCEAN IMAGERY**

R. O. HARGER (Maryland, University, College Park, MD) IEEE Journal of Oceanic Engineering (ISSN 0364-9059), vol. OE-9, Oct. 1984, p. 266-276. Research supported by the Environmental Research Institute of Michigan and U.S. Navy. refs (Contract NAGW-387)

Employing a synthetic aperture radar (SAR) imaging model based on fundamental models of nonlinear hydrodynamics, electromagnetic scattering from a two-scale surface, and SAR imaging of a time-variant scene, the optimal (minimum mean-square error) estimates of the parameters of a sinusoidal, long gravity wave, and the short gravity wave ensemble are found in an efficient recursive form and their performance evaluated, generally by numerical simulation, in a one-dimensional stationary version. An application is made to Seasat-SAR complex imagery. Author

**N85-10580\*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

### **THE MARINE RESOURCES EXPERIMENT PROGRAM (MAREX)**

Dec. 1982 119 p refs  
(NASA-TM-87368; NAS 1.15:87368) Avail: NTIS HC A06/MF A01 CSCL 08C

The Satellite Ocean Color Science Working Group was established to consider the scientific utility of repeated satellite measurements of ocean color, especially for measuring global ocean chlorophyll and for studying the fate of global primary productivity in the sea. Results of the group's deliberations are presented. The scientific requirements are given for ocean color data from a CZCS follow on sensor in order to address global primary productivity, fishery, and carbon storage problems. Some specific experiments, called the marine resource experiment and designed to determine critical nutrient fluxes, photosynthetic rates, and primary productivity and biomass, are outlined. R.S.F.

**N85-10596#** Naval Research Lab., Washington, D. C.

### **A DESCRIPTION AND DISCUSSION OF FREDDEX OCEANOGRAPHIC MEASUREMENTS Interim Report**

J. M. BERGIN 19 Jun. 1984 23 p  
(AD-A145032; AD-E000587; NRL-MR-5359) Avail: NTIS HC A02/MF A01 CSCL 08C

During the time interval March June 1979 an experiment called FREDDEX (Front and Eddy Experiment) was conducted in the Atlantic Ocean, north of Bermuda, as a cooperative effort between several organizations and involved measurements made from satellite, aircraft, and three ships. The purpose of FREDDEX was to conduct extensive measurements on the oceanographic characteristics of an ocean eddy and the influence this feature has on long range underwater acoustic transmission. This report discusses various salient aspects of the oceanographic measurements. Results are given for horizontal and vertical temperature structure of the eddy as well as evidence for the rotation of the basic temperature anomaly associated with the eddy. A novel technique is described of utilizing the ensemble of measurements in order to extend the data to the ocean bottom, thereby achieving a complete description of the sound speed profile in the vertical. GRA

**N85-10604#** National Oceanic and Atmospheric Administration, Seattle, Wash. Pacific Marine Environmental Lab.

### **DRIFT CHARACTERISTICS OF NORTHEASTERN BERING SEA ICE DURING 1982**

M. REYNOLDS and C. H. PEASE Apr. 1984 144 p refs  
(PB84-213982; NOAA-TM-ERL-PMEL-55; NOAA-84062802)  
Avail: NTIS HC A07/MF A01 CSCL 08L

An array of 6 ARGOS drifting ice platforms were deployed in the vicinity of Nome, Alaska in the northeastern Bering Sea. Two of the platforms had meteorological and oceanographic stations which measured surface winds and currents and telemetered the data to the GOES-West satellite. During this time the NOAA WP-3D instrumented airplane made three flights over this area and out to the ice edge. The ARGOS platforms were allowed to drift freely

and terminated in the ice pack due to ice deformation or to melt out. The two platforms in Norton Sound oscillated north and south on the same time scales as the others but were restricted to the spatial scales of western Norton Sound. GRA

**N85-11432\*#** Kansas Univ. Center for Research, Inc., Lawrence. Remote Sensing Lab.

### **ACTIVE MICROWAVE MEASUREMENTS OF SEA ICE UNDER FALL CONDITIONS: THE RADARSAT/FIREX FALL EXPERIMENT**

R. G. ONSTOTT, Y. S. KIM, and R. K. MOORE Jun. 1984 100 p refs Sponsored in part by Atmospheric Environment Service of Canada ERTS

(Contract NAGW-334; N00014-76-C-1105)

(E85-10019; NASA-CR-168576; NAS 1.26:168576;

RSL-TR-331-30/578-FINAL) Avail: NTIS HC A05/MF A01

CSCL 08L

A series of measurements of the active microwave properties of sea ice under fall growing conditions was conducted. Ice in the inland waters of Mould Bay, Crozier Channel, and intrepid inlet and ice in the Arctic Ocean near Harding Bay was investigated. Active microwave data were acquired using a helicopter borne scatterometer. Results show that multiyear ice frozen in grey or first year ice is easily detected under cold fall conditions. Multiyear ice returns were dynamic due to response to two of its scene constituents. Floe boundaries between thick and thin ice are well defined. Multiyear pressure ridge returns are similar in level to background ice returns. Backscatter from homogeneous first year ice is seen to be primarily due to surface scattering. Operation at 9.6 GHz is more sensitive to the detailed changes in scene roughness, while operation at 5.6 GHz seems to track roughness changes less ably. R.S.F.

**N85-11515** Florida State Univ., Tallahassee.

### **A STUDY OF HIGHLY ENERGETIC NEAR-BOTTOM OCEAN FLOW AT THE BASE OF THE SCOTIAN RISE Ph.D. Thesis**

E. A. KELLEY, JR. 1984 120 p

Avail: Univ. Microfilms Order No. DA8416711

A comparison is made of long (8-12 mos) records of three near bottom current meters with satellite derived frontal positions of Gulf Stream meanders and rings. The energetic fluctuations coincide with, and most probably, result from the movement of Gulf Stream meanders and rings. The strong equatorward contour following flow near the 4,900 m isobath is decoupled from, and not part of, the Deep Western Boundary Current. A search of archived hydrographic data of the western North Atlantic shows the Cold Filament to be an ubiquitous feature near the base of the Continental Rise from the Grand Banks Ridge. A rough estimate of the dissipation of eddy kinetic energy as a result of the interaction of the Gulf Stream meanders and rings with the bottom indicates that this mechanism may account for roughly 50% of the energy input by the wind into the subtropical gyre of the western North Atlantic. Dissert. Abstr.

**N85-11516#** Alaska Univ., Fairbanks. Geophysical Inst.

### **HANDBOOK FOR SEA ICE ANALYSIS AND FORECASTING Final Report**

W. J. STRINGER, D. G. BARNETT, and R. H. GODIN Jun. 1984 275 p

(Contract N00228-81-C-H553)

(AD-A145286; NERPF-CR-84-03) Avail: NTIS HC A12/MF A01 CSCL 08L

Background information and techniques used to analyze and forecast sea ice conditions are presented. Emphasis has been placed on operationally-oriented analysis and forecast rules and aids and the use of climatological charts containing parameters related directly to operational decision-making based on sea ice conditions. Subject material includes sea ice morphology, characteristics and dynamics, global and regional sea ice distribution and behavior, sea ice modeling, remote sensing principles and techniques, remote sensing systems used for sea ice analysis, auxiliary sea ice observations, meteorological and

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climatological relationships with sea ice, operational sea ice analysis, and sea ice forecasting techniques. Author (GRA)

**N85-11519#** Sandia Labs., Albuquerque, N. Mex. **HIGH-DATA-RATE WIDE-ANGLE UNDERWATER ACOUSTIC TELEMETRY SYSTEM**

D. E. RYERSON and G. C. HAUSER Jul. 1984 57 p refs (Contract DE-AC04-76DP-00789)

(DE84-015696; SAND-84-0994) Avail: NTIS HC A04/MF A01

A high data rate wide angle underwater acoustic telemetry system is developed. The system is used to transmit data from subsurface ocean instrumentation to unattended ocean data buoys. The data are transmitted from the buoys to shore via the GOES satellites. This report describes the system, the design decisions behind it, and the results of a trial installation in the Gulf of Mexico. DOE

**N85-12419#** European Space Agency, Paris (France).

**ERS-1 RADAR ALTIMETER DATA PRODUCTS**

T. GUYENNE, ed. and J. J. HUNT, ed. Aug. 1984 266 p refs Proc. of ESA Workshop, Frascati, Italy, 5-11 May 1984 Original contains color illustrations

(ESA-SP-221; ISSN-0379-6566) Avail: NTIS HC A12/MF A01

The ERS-1 (ESA satellite) wind, wave, sea ice, and topography data products were discussed. The altimeter off-line ground segment, and altimeter system design aspects were covered.

**N85-12420#** Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

**THE ESA REMOTE SENSING SATELLITE SYSTEM (ERS-1)**

E. H. VELTEN In ESA ERS-1 Radar Altimeter Data Prod. p 3-8 Aug. 1984 refs

Avail: NTIS HC A12/MF A01

Mission objectives, spacecraft and payload support, payload instruments, instrument data handling and transmission, and ground segment of ERS-1 (ESA) are outlined. An active-microwave C-band instrument measures wind fields and wave image spectra and provides all-weather high resolution images of coastal zones, open oceans, ocean ice areas and images over land. A Ku-band radar altimeter measures significant wave-height, wind speed, and provides measurements over ice and major ocean currents. Laser retroreflectors for accurate satellite tracking from the ground, as a complement for the radar-altimeter, are included. An along-track-scanning radiometer with a microwave sounder, and the Precise Range and Range Rate Experiment complete the payload. Author (ESA)

**N85-12424#** Centre Oceanologique de Bretagne, Brest (France).

**WIND SPEED DETERMINATION FROM RADAR ALTIMETERS**

P. QUEFFEULOU In ESA ERS-1 Radar Altimeter Data Prod. p 31-35 Aug. 1984 refs

Avail: NTIS HC A12/MF A01

Satellite radar altimeter wind speed determination is reviewed. The altimeter wind algorithm underestimates high wind speeds. The backscatter coefficient accuracy is shown to be a very important parameter for accurate wind speed estimation. For tuning algorithm coefficients with surface data, the temporal and spatial variability of wind at sea has to be carefully investigated. Author (ESA)

**N85-12425#** Centre National d'Etudes Spatiales, Toulouse (France).

**OCEAN WAVE PARAMETERS EXTRACTION USING SATELLITE SHORT-PULSE RADAR ALTIMETERS**

N. M. MOGNARD In ESA ERS-1 Radar Altimeter Data Prod. p 37-41 Aug. 1984 refs

Avail: NTIS HC A12/MF A01

Measurement of significant wave height and surface wind speed by satellite-borne radar altimeter to infer other sea state parameters such as minimum significant swell height and wind wave spectra is discussed. Examples of minimum swell generation, propagation,

and attenuation and wind wave spectra are shown, using data from the SEASAT radar altimeter. Author (ESA)

**N85-12426#** Service Meteorologique Metropolitan, Paris (France).

**THE USE OF ALTIMETER DATA FOR SEA STATE FORECASTING**

A. GUILLAUME In ESA ERS-1 Radar Altimeter Data Prod. p 43-46 Aug. 1984 refs

Avail: NTIS HC A12/MF A01

Sea state analysis and forecasting methods are reviewed, and the contribution of the ERS-1 (ESA) radar altimeter to sea state forecasting is discussed. It is shown that altimeter data can be used to elaborate a significant wave height (SWH) analysis, which at present is not possible because of lack of data or of their poor quality. But, as no spectra are available, it does not meet the analysis needs of forecasting models. The SWH data set collected by ERS-1 will be useful for model development, tuning, validating or comparison, and for climatological studies. Nevertheless, other means still remain necessary, as the efforts for a better understanding of basic phenomena in sea state evolution (nonlinear transfer, finite depth transformation, etc.) must be continued. Author (ESA)

**N85-12427#** Institute of Oceanographic Sciences, Wormley (England).

**THE IMPACT OF SATELLITE ALTIMETER DATA ON WAVE RESEARCH**

D. J. T. CARTER and P. G. CHALLENGER In ESA ERS-1 Radar Altimeter Data Prod. p 47-50 Aug. 1984 refs Sponsored by UK Ministry of Industry and ESA

Avail: NTIS HC A12/MF A01

It is argued that the main contribution of satellite altimetry to ocean wave research will be in transferring attention from the time domain to spatial aspects of ocean waves, on long and short scales. Understanding of the sea surface over short distances, within the footprint of the altimeter, is essential for interpreting the altimeter return and this will influence work in short term wave statistics. On longer scales the altimeter data will provide information on the spatial scales of the ocean wave field and on wave climate over all the world's oceans. The influence of the altimeter on wave modelling is considered. Author (ESA)

**N85-12428#** Cambridge Univ. (England).

**CRYOSPHERIC DATA PRODUCTS AVAILABLE THROUGH SATELLITE ALTIMETRY**

V. A. SQUIRE, D. J. DREWRY, A. M. COWAN, and N. F. MCINTYRE (Mullard Space Science Laboratory) In ESA ERS-1 Radar Altimeter Data Products p 51-57 Aug. 1984 refs Sponsored by Natural Environmental Research Council of Great Britain, ESA, Navy and British Petroleum Co.

Avail: NTIS HC A12/MF A01

The extraction of glaciological parameters from satellite radar altimetry over continental ice and sea ice is discussed in the context of geophysical and oceanographic data products for applications and research use. Each parameter is discussed with reference to its scientific value and to difficulties which occur in processing. Although nontrivial to interpret, the altimeter waveform over ice-covered terrain or sea contains information which in many cases can be obtained by no other method. Author (ESA)

**N85-12429#** University Coll., London (England). Dept. of Electronic and Electrical Engineering.

**SPECIAL DIFFICULTIES OF RETRIEVING SURFACE ELEVATION OVER CONTINENTAL ICE**

H. D. GRIFFITHS In ESA ERS-1 Radar Altimeter Data Prod. p 61-65 Aug. 1984 refs

Avail: NTIS HC A12/MF A01

Differences between radar returns from ice sheets and oceans are reviewed for the ERS-1 mission, and optimum organization of the satellite orbit repeat and ground segment data processing are discussed. To provide adequate cross-track slope information a long repeat cycle is desirable. However, to detect changes in



elevation this only needs to be repeated infrequently. Ice sheet elevation measurements should be repeated with similar instruments at decade intervals. Waveform retracking is best carried out by a dedicated hardware processor, fitting one of a number of idealized profiles to the data to derive corrected range values. Corrected values of range rate could be calculated, as the first stage of correction of slope-induced error. The onboard computed range rate values from the alpha-beta tracker form a simple method of correcting along-track slope-induced error. Author (ESA)

**N85-12430#** Oxford Univ. (England).

### REQUIREMENTS AND SPECIAL PROBLEMS OF LAND ALTIMETRY

J. G. OLLIVER /in ESA ERS-1 Radar Altimeter Data Prod. p 67-71 Aug. 1984 refs  
 Avail: NTIS HC A12/MF A01

Land observations by altimeter satellites are discussed. Justification for undertaking such observations is given, and the technique for obtaining land data from altimeters designed for oceanographic investigation is described. Technical requirements for a dedicated land altimeter mission are discussed. The behavior of the altimeter over inland water surfaces is considered.

Author (ESA)

**N85-12432#** Bonn Univ. (West Germany). Inst. fuer Theoretische Geodäsie.

### DETERMINATION OF GEOID UNDULATIONS AND OCEAN HEIGHTS FROM ERS-1 RADAR ALTIMETRY DATA

K. R. KOCH /in ESA ERS-1 Radar Altimeter Data Prod. p 79-82 Aug. 1984 refs  
 Avail: NTIS HC A12/MF A01

A method to separate satellite geoidal heights from the time varying heights of the sea surface in the altimetry heights is outlined. The method is based on the frequency analysis of the altimetry data to detect the time varying heights and on crossover analysis augmented by a least squares filtering and prediction to determine the geoid undulations. The separation can only be achieved iteratively.

Author (ESA)

**N85-12433\*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

### THE NASA/JPL PILOT OCEAN DATA SYSTEM

J. W. BROWN and J. C. KLOSE /in ESA ERS-1 Radar Altimeter Data Prod. p 85-89 Aug. 1984 refs Sponsored by NASA  
 Avail: NTIS HC A12/MF A01

The Pilot Ocean Data System was developed to investigate techniques for archiving and distributing ocean data obtained from space. The system includes a technique for efficient storage and rapid retrieval of satellite data, an easy-to-use user interface, and a variety of output products which, taken together, permit researchers to extract and use data rapidly and conveniently. A set of analysis tools together with convenient access to data enables the research community to understand and improve the data archives in ways which would not otherwise be feasible.

Author (ESA)

**N85-12434#** Institute of Oceanographic Sciences, Birkenhead (England). Marine Information and Advisory Service.

### INTERNATIONAL BANKING OF SATELLITE AND IN-SITU WAVE DATA BY THE MARINE INFORMATION AND ADVISORY SERVICES (MIAS)

M. T. JONES and A. R. TABOR /in ESA ERS-1 Radar Altimeter Data Prod. p 91-98 Aug. 1984 refs  
 Avail: NTIS HC A12/MF A01

The role of the Marine Information and Advisory Service in the international cataloguing and banking of instrumentally collected wave data and its function as the Responsible National Oceanographic Data Centre (Waves) designated by the International Oceanographic Data Exchange Working Committee of the Intergovernmental Oceanographic Commission are described. Data holdings, and data banking and retrieval methods are outlined. Aspects of satellite-recorded wave data are examined,

and suggestions for the way in which such data should be banked, indexed, and retrieved are proposed. Author (ESA)

**N85-12436#** Centre National d'Etudes Spatiales, Toulouse (France).

### ERS-1 ALTIMETER GROUND SEGMENT RELATIONS TO OTHER SENSORS AND PROGRAMS

A. DELEFFE /in ESA ERS-1 Altimeter Radar Data Prod. p 103-109 Aug. 1984 refs  
 Avail: NTIS HC A12/MF A01

It is argued that ERS-1 radar altimeter data cannot be considered and processed totally independently of the other satellite altimeters, nor of any other sensors measuring wind, waves or surface topography. Microwave sounder data must be merged systematically with altimeter data at an early stage of the processing. Calibration and data validation should be coordinated with other projects embarking altimeters for a better use of existing facilities and for intercalibration and data comparison. High level products must be standardized as far as possible. Precise dating of radar altimeter measurements (with an accuracy of 100 to 300 microsec) is mandatory. Otherwise possibilities of precise in-orbit altitude calibration and of precise orbit determination are wasted.

Author (ESA)

**N85-12437#** Royal Netherlands Meteorological Inst., De Bilt. **IMPACT OF ERS-1 OBSERVATIONS ON WAVE FORECASTING IN THE NORTH SEA**

E. BOUWS, G. J. KOMEN, and G. J. L. NOOREN (National Aerospace Laboratory, Amsterdam, Netherlands) /in ESA ERS-1 Radar Altimeter Data Prod. p 113-116 Aug. 1984 refs  
 Avail: NTIS HC A12/MF A01

Wave forecasting in the North Sea with and without ERS-1 data is discussed. The measurement network in the North Sea is dense in the south, but very few measurements exist north of latitude 62. The numerical wave forecasting model uses atmospheric data from a numerical atmospheric model, because measurements in the north, which are very important for swell in the south, are not available. A typical case of model mis-prediction, where conclusions cannot be drawn through lack of data (either wind or wave) in the north is described. The ERS-1 data will be extremely useful here. In the southern part of the North Sea, ERS-1 will not add much data, especially if the influence of the coast is taken into account. Further to the north, the amount of ERS-1 data becomes comparable to the amount of surface data, albeit with a totally different spatial and temporal distribution.

Author (ESA)

**N85-12439#** Institute of Oceanographic Sciences, Wormley (England).

### EXTRACTION OF WAVE PERIOD FROM ALTIMETER DATA

P. G. CHALLENGER and M. A. SROKOSZ /in ESA ERS-1 Radar Altimeter Data Prod. p 121-124 Aug. 1984 refs Sponsored by ESA and UK Department of Industry  
 Avail: NTIS HC A12/MF A01

The method of extracting wave period information from radar altimeter data, based on altimeter skewness measurements and a relationship between skewness and significant slope is shown to be questionable, as no unique relationship appears to exist connecting skewness to significant slope for all sea states. An approach based on altimeter slope measurements and wave spectrum properties leads to the definition of a period parameter which may be related to zero-upcrossing and crest period parameters.

Author (ESA)

**N85-12440#** Scott Polar Research Inst., Cambridge (England). **SEA ICE CHARACTERISTICS DERIVED FROM AIRBORNE ALTIMETRY**

A. M. COWAN and V. A. SQUIRE /in ESA ERS-1 Radar Altimeter Data Prod. p 125-127 Aug. 1984 refs  
 Avail: NTIS HC A12/MF A01

A microwave altimeter/scatterometer was flown over sea ice during the Marginal Ice Zone Experiment in the Bering Sea. Supporting data, especially from aerial photography, is used to

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provide a model input to a waveform simulation program designed for the ERS-1 altimeter and to interpret the altimeter data. Sea ice characteristics particular to the Bering Sea are described.

Author (ESA)

**N85-12441#** Science Research Council, Chilton (England).

### **RADAR ALTIMETRY OVER SEA ICE**

R. J. POWELL, A. R. BIRKS, C. L. WRENCH, W. J. BRADFORD, and B. F. MADDISON /In ESA ERS-1 Radar Altimeter Data Prod. p 129-133 Aug. 1984

Avail: NTIS HC A12/MF A01

Remote sensing of sea ice in the Marginal Ice Zone Experiment is described. A 13.7 GHz microwave radar altimeter/scatterometer, a 19 GHz electronically scanning microwave radiometer, scanning radiometers at 92 and 183 GHz, and an infrared, nadir pointing, temperature sounder were used; SLAR imagery and laser profilometry were collected in the same area from an aircraft and a large number of surface data were collected from ships. Data analysis using simple algorithms suggests that the relatively low bit rate data from satellite microwave altimeters and radiometers can be used together to provide better characterization of the marginal ice zone and its interaction with ocean waves on a global basis.

Author (ESA)

**N85-12442#** Bergen Univ. (Norway). Dept. of Oceanography.

### **EDDY DETECTION IN THE NORWEGIAN, GREENLAND, AND BARENTS SEAS WITH A RADAR ALTIMETER**

J. A. JOHANNESSEN /In ESA ERS-1 Radar Altimeter Data Prod. p 135-139 Aug. 1984 refs Sponsored by Royal Norwegian Council for Scientific and Industrial Research Original contains color illustrations

Avail: NTIS HC A12/MF A01

SEASAT altimeter data obtained in the Norwegian Sea were analyzed in order to study height variations associated with transient mesoscale features with a scale of 50 to 100 km. Significant height variations associated with two such features were found. Sufficient surface truth to verify these results does not exist. The possibility of detection of eddies along the ice edge in the marginal ice zone between Svalbard and Greenland is discussed. Results of dynamic height computations of a large topographic eddy in the Fram Strait suggest that it can be detected by satellite altimetry.

Author (ESA)

**N85-12443#** Institute of Oceanographic Sciences, Wormley (England).

### **SEASAT ALTIMETER DATA OVER THE MEDITERRANEAN: IMPLICATIONS FOR ERS-1**

T. H. GUYMER and T. D. ALLAN /In ESA ERS-1 Radar Altimeter Data Prod. p 141-145 Aug. 1984 refs

Avail: NTIS HC A12/MF A01

Techniques to minimize orbit and geoid errors when deriving sea surface slopes associated with ocean currents using satellite altimeter range data are described. One relies solely on using tracks from the period when SEASAT was in a 3-day repeat orbit and applies a tilt plus bias correction to remove the long wavelength effects of orbit uncertainty. The second references these data to an independently derived sea surface from an earlier part of the mission; NOAA IR imagery and SEASAT scatterometer data are used in the interpretation of features. The western Mediterranean is advocated for ERS-1 calibration zone, since the geoid is homogeneous, the skies are sufficiently clear for laser tracking, there are large areas of low mesoscale ocean variability, sea states are low, and tides are small and well known.

Author (ESA)

**N85-12444#** Imperial Coll. of Science and Technology, London (England). Dept. of Physics.

### **SATELLITE ALTIMETRY FOR SEA-SURFACING TOPOGRAPHY DETERMINATION AND GEOID IMPROVEMENT**

J. C. MARSHALL /In ESA ERS-1 Radar Altimeter Data Prod. p 147-151 Aug. 1984 refs

Avail: NTIS HC A12/MF A01

The combined problem of determining the ocean circulation and improving the geoid from satellite altimetry was investigated

in a simulation study of mesoscale variability. The use of a dynamical ocean model as a source of a-priori oceanographic information capable of discriminating between geoid errors and sea surface topography is described. Results show that better estimates of the sea surface topography and the geoid can be made by solving for them simultaneously rather than separately; even dynamical information is useful; and a dynamical ocean model can be used to discriminate between geoid errors and geostrophically balanced pressure gradients.

Author (ESA)

**N85-12446#** Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).

### **DETERMINATION OF THE ALTIMETRIC GEOID AND GRAVITY ANOMALIES IN THE NORTH SEA: IMPLICATIONS FOR A SOLUTION OF THE GENERAL CIRCULATION PROBLEM USING ERS-1 DATA**

D. LELGEMANN /In ESA ERS-1 Radar Altimeter Data Prod. p 161-164 Aug. 1984 refs

Avail: NTIS HC A12/MF A01

Results of the SEASAT Users Research Group of Europe validation project in the North Sea relevant to ERS-1 are discussed. For ERS-1, sampling of altimeter data (requiring a 35-day repetition rate orbit) over a period of 6 cycles (6 months) is suggested. Computation of mean sea surface heights, gravity anomalies and gravity disturbances at an equidistant grid for geophysical applications is proposed. Use of ship gravity observations over a test area defined by oceanographers to detect in the altimetric gravity signal the part due to sea surface topography is advocated. If this is successful, ship gravity measurements over the major ocean currents can be organized even after the ERS-1 mission, to solve the general circulation problem.

Author (ESA)

**N85-12447#** University Coll., London (England). Mullard Space Science Lab.

### **SATELLITE ALTIMETRIC MEASUREMENTS OF LAKE LEVELS**

I. M. MASON, C. G. RAPLEY, F. A. STREET-PERROTT (Oxford Univ.), and S. P. HARRISON (Oxford Univ.) /In ESA ERS-1 Radar Altimeter Data Prod. p 165-169 Aug. 1984 refs

Avail: NTIS HC A12/MF A01

The performance of radar altimetry over lakes is summarized. Results show that even with ocean-optimized altimeters such as those on SEASAT or ERS-1 it is possible to monitor lakes down to 70 sq km in area. There should be up to 1 lake per orbit measured, representing up to 200 lakes for a typical 14 day orbital repeat period (including 70% of lakes 250 sq km in area). For calm, specularly reflecting lakes, there is a possibility of measuring several hundred more lakes down to 150 m in diameter. The need for the ERS-1 ground segment to be able to support this data product is noted.

Author (ESA)

**N85-12448#** Scott Polar Research Inst., Cambridge (England).

### **SIMULATION OF WAVEFRONTS RETURNED BY REALISTIC SURFACES**

E. NOVOTNY, A. P. R. COOPER, and M. R. GORMAN /In ESA ERS-1 Radar Altimeter Data Prod. p 171-170 Aug. 1984

Avail: NTIS HC A12/MF A01

A computer program for waveform simulation which permits detailed analyses to be made of the returned signals from a large variety of simple and complex model surfaces representing open water, sea ice, and land ice, is introduced. These aid the study of real waveforms returned by a radar altimeter, in order to deduce the character of the terrain over which the altimeter flew. The program is written in ANSI standard FORTRAN 77.

Author (ESA)

**N85-12449#** Scott Polar Research Inst., Cambridge (England).

### **ICE SHEETS AS INVARIANT SURFACES FOR RADAR ALTIMETER CALIBRATION AND ORBIT DETERMINATION**

M. R. GORMAN and D. J. DREWRY /In ESA ERS-1 Radar Altimeter Data Prod. p 173-176 Aug. 1984

Avail: NTIS HC A12/MF A01

Use of the Greenland and Antarctic continental ice sheets, and the large floating ice shelves surrounding the Antarctic



continent to provide stable and smooth surfaces for calibration and validation of the ERS-1 radar altimeter, and short arc orbit determination is discussed. Error sources are considered, and an error budget is presented. It is concluded that ice sheets offer the potential for a more precise calibration, compared to a low latitude, sea level site. Author (ESA)

**N85-12450#** University Coll., London (England). Dept of Electronic and Electrical Engineering.  
**MODELLING OF ALTIMETER TRACKING OVER TOPOGRAPHICAL SURFACES**  
C. G. RAPLEY and H. D. GRIFFITHS /in ESA ERS-1 Radar Altimeter Data Prod. p 177-180 Aug. 1984 refs  
Avail: NTIS HC A12/MF A01

Computer generated pulse streams representative of ice sheet returns were used to explore ways of improving altimeter performance. An analysis of ice sheet terrain in Antarctica suggests that with relatively simple modifications the SEASAT design could provide 70% coverage of the Antarctic ice sheet north of 82 deg. Use of an ice mode on ERS-1 will permit even more complete coverage. Author (ESA)

**N85-12452#** Selenia S.p.A., Rome (Italy).  
**SIMULATION OF INFORMATION EXTRACTION FROM RADAR ALTIMETER RETURN ECHOES**  
G. LOSQUADRO and R. SOMMA /in ESA ERS-1 Radar Altimeter Data Prod. p 187-192 Aug. 1984 refs  
Avail: NTIS HC A12/MF A01

The ERS-1 (ESA) radar altimeter performance over ice and ocean was simulated, and the effects of a mispointing tracking loop (MTL) were studied. Results validate the suboptimal maximum likelihood estimate (SMLE) tracking procedure. The resulting accuracies improve on the SEASAT radar altimeter. The introduction of the weighted center of gravity gives the ERS-1 altimeter great operational flexibility; this mode of operation could be used over ocean and over sea ice, which can also be tracked by SMLT. The MTL correction loop renders altimeter performance practically independent of the performances of the satellite attitude control. Author (ESA)

**N85-12453#** European Space Agency, Paris (France).  
**THE ALTIMETER AS A SUPPORT TO THE SCATTEROMETER IN THE REPRESENTATION OF WINDS AND DERIVED WAVE FIELDS IN COASTAL WATERS AND ENCLOSED SEAS: A RESEARCH AT ITS ONSET**  
R. FRASSETTO (EARSeL Working Group 2), T. GUYMER (EARSeL Working Group 2), S. ZECCHETTO (EARSeL Working Group 2), C. BROSSIER (EARSeL Working Group 2), L. CIRAOLO (EARSeL Working Group 2), and C. G. RAPLEY (EARSeL Working Group 2) /in its ERS-1 Radar Altimeter Data Prod. p 193-197 Aug. 1984  
Avail: NTIS HC A12/MF A01

Research on the symbiotic use of altimeter, scatterometer and radiometer in semiencllosed seas and coastal waters is introduced. Analysis of SEASAT altimeter data near coastlines and of the coverage of SASS (SEASAT scatterometer) in the Mediterranean is presented. Author (ESA)

**N85-12454#** Centre National d'Etudes Spatiales, Toulouse (France).  
**THE POSEIDON ALTIMETER DESCRIPTION**  
P. RAZONVILLE /in ESA ERS-1 Radar Altimeter Data Prod. p 199-204 Aug. 1984 refs  
Avail: NTIS HC A12/MF A01

An altimeter for an ocean circulation study is described. The design is based on the SEASAT altimeter. Pulse length is 100 microsec, bandwidth is 330 MHz, and compressed pulse length 3.03 nsec. Power amplification is performed by a solid state amplifier, output power is 2W. Author (ESA)

**N85-12456#** Centre National d'Etudes Spatiales, Toulouse (France). Groupe de Recherche de Geodesie Spatiale.  
**CALIBRATION AND VALIDATION AREAS**  
Y. MENARD /in ESA ERS-1 Radar Altimeter Data Prod. p 209-213 Aug. 1984 refs  
Avail: NTIS HC A12/MF A01

Difficulties in calibrating the SEASAT altimeter using the Bermuda laser site are recalled, and the use of Dakar (Senegal) for altimeter calibration is discussed. The site is flat, has clear skies for 200 to 250 days per year, and a local tide model is available. Atmospheric parameters can be studied using existing facilities with two additional weather stations. Author (ESA)

**N85-12538#** Lamont-Doherty Geological Observatory, Palisades, N. Y.  
**PHYSICAL OCEANOGRAPHY REPORT. HELICOPTER-BASED STD DATA FROM MIZEX 83 (MARGINAL ICE ZONE EXPERIMENT) Technical Report**  
T. O. MANLEY, D. CAMP, K. HUNKINS, and W. TIEMANN Sep. 1984 148 p  
(Contract N00014-76-C-0004)  
(AD-A145848; LDGO-84-3) Avail: NTIS HC A07/MF A01  
CSCL 08J

During the 1983 Marginal Ice Zone Experiment (MIZEX 83) located in the Fram Strait, both ship and helicopter-based C/STD's were used to define the finescale and larger oceanographic structures within the operational area. This technical report outlines the acquisition and data reduction programs for the 120 helicopter-based stations taken during that time period. Very little manipulation was done to the data to finalize it, since both helicopter C/STD's showed very little deviation from pre- and post-cruise calibrations. The only exception was the calibration equation offsets for conductivity on both instruments. For these offset determinations, bottle and intercalibration data were used to define the coefficients. Response time of the temperature sensor was corrected for thermal lag constant until descending and ascending parts of the cast on a T-S diagram were nearly congruent. Standard level listings of temperature, potential temperature, salinity, sigma-t, specific volume anomaly, dynamic height, and sound velocity are given for each cast along with plotted profiles of temperature, salinity and sigma-t. GRA

**N85-13445\*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.  
**OCEAN SERVICES USER NEEDS ASSESSMENT. VOLUME 1: SURVEY RESULTS, CONCLUSIONS AND RECOMMENDATIONS Final Report**  
D. R. MONTGOMERY, R. J. PATTON (Dynamics Technology, Inc.), and S. W. MCCANDLESS (User Systems, Inc.) 5 Apr. 1984 141 p Sponsored in part by NOAA  
(Contract NAS7-918)  
(NASA-CR-174104; JPL-PUB-84-19; NAS 1.26:174104) Avail: NTIS HC A07/MF A01 CSCL 08J

An interpretation of environmental information needs of marine users, derived from a direct contact survey of eight important sectors of the marine user community is presented. Findings of the survey and results and recommendations are reported. The findings consist of specific and quantized measurement and derived product needs for each sector and comparisons of these needs with current and planned NOAA data and services. The following supportive and reference material are examined: direct contact interviews with industry members, analyses of current NOAA data gathering and derived product capabilities, evaluations of new and emerging domestic and foreign satellite data gathering capabilities, and a special commercial fishing survey conducted by the Jet Propulsion Laboratory (JPL). E.A.K.

## 05 OCEANOGRAPHY AND MARINE RESOURCES

**N85-13446\*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

### **MULTISENSOR SATELLITE DATA INTEGRATION FOR SEA SURFACE WIND SPEED AND DIRECTION DETERMINATION** **Final Report**

D. L. GLACKIN, G. G. PIHOS, and S. L. WHEELLOCK 30 Mar. 1984 80 p refs Sponsored in part by the Department of the Navy

(Contract NAS7-918)

(NASA-CR-174162; NAS 1.26:174162) Avail: NTIS HC A05/MF A01 CSCL 08J

Techniques to integrate meteorological data from various satellite sensors to yield a global measure of sea surface wind speed and direction for input to the Navy's operational weather forecast models were investigated. The sensors were launched or will be launched, specifically the GOES visible and infrared imaging sensor, the Nimbus-7 SMMR, and the DMSP SSM/I instrument. An algorithm for the extrapolation to the sea surface of wind directions as derived from successive GOES cloud images was developed. This wind veering algorithm is relatively simple, accounts for the major physical variables, and seems to represent the best solution that can be found with existing data. An algorithm for the interpolation of the scattered observed data to a common geographical grid was implemented. The algorithm is based on a combination of inverse distance weighting and trend surface fitting, and is suited to combining wind data from disparate sources.

E.A.K.

**N85-13450#** Alaska Univ., Fairbanks. Geophysical Inst.  
**ARCTIC ICE ISLAND AND SEA ICE MOVEMENTS AND MECHANICAL PROPERTIES** Quarterly Report, 1 Jan. - 31 Mar. 1984

W. M. SACKINGER, W. J. STRINGER, and H. SERSON 1984 189 p refs

(Contract DE-AC21-83MC-20037)

(DE84-016323; DOE/MC-20037/1644; QR-2) Avail: NTIS HC A09/MF A01

Research activities are presented for the following tasks: (1) ice island; (2) Chukchi Sea pack ice age; and (3) mechanical properties of sea spray ice bonds structures. The research program on ice islands has four objectives: (1) establish a time history of all of the Arctic ice shelves and an historically verified source function for ice islands through the use of aerial photography, satellite buoys on the existing ice islands to track their trajectories daily and to telemeter daily barometric pressure and temperature, via system Argos; (3) relate geostrophic winds to the observed trajectories; and (4) build a pseudo random model for ice island motion over the long term which will enable a determination of the probability of interaction ice islands and offshore structures.

DOE

**N85-13816#** Centre National d'Etudes Spatiales, Toulouse (France). Div. DTI/MS/CD.

### **TERRESTRIAL LOCATING [LA LOCALISATION TERRESTRE]**

B. BOUCHERDELARUELLE *In its* Satellite Motion: Lectures and Exercises on Space Mech. p 395-416 1984 refs In FRENCH

Avail: NTIS HC A99/MF A01

The use of spaceborne Doppler radar to pinpoint buoys used for ocean data acquisition and search and rescue missions is described. The ARGOS oceanography project, involving position estimation of 4000 buoys in 24 hr with 1 km accuracy, and the SARGOS search and rescue project, locating 40 buoys within 90 min with accuracy of a few kilometers, are outlined.

Author (ESA)

**N85-14195\*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

### **AIR-SEA HEAT EXCHANGE, AN ELEMENT OF THE WATER CYCLE**

M. T. CHAHINE *In its* The interaction of Global Biochemical Cycles p 253-255 15 Jan. 1984 refs

Avail: NTIS HC A12/MF A01 CSCL 04A

The distribution and variation of water vapor, clouds and precipitation are examined. Principal driving forces for these distributions are energy exchange and evaporation at the air-sea interface, which are also important elements of air-sea interaction studies. The overall aim of air-sea interaction studies is to quantitatively determine mass, momentum and energy fluxes, with the goal of understanding the mechanisms controlling them. The results of general circulation simulations indicate that the atmosphere in mid-latitudes responds to changes in the oceanic surface conditions in the tropics. This correlation reflects the strong interaction between tropical and mid-latitude conditions caused by the transport of heat and momentum from the tropics. Studies of air-sea exchanges involve a large number of physical, chemical and dynamical processes including heat flux, radiation, sea-surface temperature, precipitation, winds and ocean currents. The fluxes of latent heat are studied and the potential use of satellite data in determining them evaluated. Alternative ways of inferring heat fluxes will be considered.

B.G.

**N85-14224#** Bristol Univ. (England). Dept. of Geography.

### **AN INTERACTIVE TECHNIQUE FOR SATELLITE-IMPROVED RAINFALL MONITORING**

E. C. BARRETT *In* ESA EARSeL/ESA Symp. on Integrative Approaches in Remote Sensing p 191-199 Aug. 1984 refs

Avail: NTIS HC A17/MF A01

The Bristol/NOAA Inter Active Scheme (BIAS) rainfall monitoring technique to simultaneously exploit mapped NOAA satellite imagery, plus appropriate (variable) selections of data from World Weather Watch SYNOP coded weather reports, is described. A global regression is used to translate satellite-derived cloud indices into initial rainfall estimates. These can be adjusted to take account of weather situations and local climate patterns. The data are processed on a NOAA VIRGS interactive computer system; interpretive decisions of data and patterns displayed on the VIRGS screen are made by an expert meteorological analyst. The technique is designed to permit a single analyst to assess grid square rainfall over subcontinental areas in near real time. Results of the application of BIAS to weather situation over parts of northwestern Europe and the USSR are discussed.

Author (ESA)

**N85-14226#** Technical Univ. of Denmark, Lyngby. Inst. of Electromagnetics.

### **STUDY OF THE IMPROVEMENT IN ANALYZING PASSIVE MICROWAVE REMOTE SENSING DATA BY INTEGRATED USE OF GROUND DATA**

J. S. JENSEN *In* ESA EARSeL/ESA Symp. on Integrative Approaches in Remote Sensing p 207-213 Aug. 1984 refs

Avail: NTIS HC A17/MF A01

A method for using NIMBUS-7 Scanning Multichannel Microwave Radiometer (SMMR) data in a semiencloded sea was used to estimate sea surface temperatures (SST) and wind speed (WS). The retrieval functions are calibrated by sea truth data. As the weather conditions change from day to day, the retrieval functions are also reestimated from day to day. Thereby, it is possible to use the actual correlations between the physical parameters and the SMMR-data for that day. The method was tested in a 4 day experiment in the North Sea where SST and WS are estimated with an accuracy of 0.8 K and 2.7 m/sec respectively.

Author (ESA)

## 06 HYDROLOGY AND WATER MANAGEMENT

**N85-14227#** Institute of Oceanographic Sciences, Birkenhead (England).

### **COMPONENTS OF THE TIME VARIATION OF SEA SURFACE HEIGHT FROM SEASAT ALTIMETER DATA**

P. L. WOODWORTH /In ESA EARSeL/ESA Symp. on Integrative Approaches in Remote Sensing p 215-220 Aug. 1984 refs  
Avail: NTIS HC A17/MF A01

Time-dependent components of satellite radar altimeter sea surface height measurements (the barotropic correction, significant wave height correction and the signal from ocean tides) are examined using data from the SEASAT 3-day repeat orbit. The extraction of tidal information from altimeter data is demonstrated by two complementary methods, and results from one of the methods for the East Pacific are presented. The results demonstrate the importance of the three time-dependent components, and illustrate the usefulness of the tidal extraction methods.

Author (ESA)

**N85-14368\*#** Florida State Univ., Tallahassee.

### **AN INVESTIGATION OF THE MARINE BOUNDARY LAYER DURING COLD AIR OUTBREAK**

S. A. STAGE /In NASA. Goddard Space Flight Center Global Scale Atmospheric Processes Res. Program Review p 28-30 Nov. 1984 refs

Avail: NTIS HC A11/MF A01 CSCL 04B

Various aspects of the marine atmospheric boundary layer (MABL) during cold air outbreak using data from the Mesoscale Air Sea Interaction Experiment (MASEX) and using a model for the MABL developed by Stage and Businger (1981,b) were studied. Several areas were identified for emphasis in this project: (1) determination of the momentum budget and divergence of the MABL; (2) development and testing of techniques for the remote determination of ocean surface sensible and latent heat fluxes by use of satellite data; (3) use of MASEX data to evaluate various techniques for parameterizing layer turbulence, to determine the typical magnitudes of such parameters and to improve the MABL model; and (4) use of the resulting MABL model and understanding of layer parameters to develop and evaluate more sophisticated schemes for remotely sensing layer evolution and sea surface sensible and latent heat fluxes.

B.G.

**N85-14369\*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

### **STRUCTURE AND GROWTH OF THE MARINE BOUNDARY LAYER**

M. MCCUMBER /In its Global Scale Atmospheric Processes Res. Program Review p 31-34 Nov. 1984

Avail: NTIS HC A11/MF A01 CSCL 04B

LANDSAT visible imagery and a one-dimensional Lagrangian boundary layer model were used to hypothesize the nature and the development of the marine boundary layer during a winter episode of strong seaward cold air advection. Over-water heating and moistening of the cold, dry continental air is estimable from linear relations involving horizontal gradients of the near-surface air temperature and humidity. A line of enhanced convection paralleling the Atlantic U.S. coast from south of New York Bay to the vicinity of Virginia Beach, VA was attributed to stronger convergence at low levels. This feature was characterized as a mesoscale front. With the assistance of a three-dimensional mesoscale boundary layer model, initialized with data obtained from the MASEX, the marine boundary layer can be mapped over the entire Atlantic coastal domain and the evolution of the boundary layer can be studied as a function of different characteristics of important surface level forcings. The effects on boundary layer growth due to the magnitude and pattern of sea surface temperature, to the shape of the coastline, and to atmospheric conditions, such as the orientation of the prevailing wind are examined.

B.G.

**N85-15195#** National Oceanic and Atmospheric Administration, Washington, D. C. National Environmental Satellite, Data, and Information Service.

### **ENVIRONMENTAL DATA INVENTORY FOR THE ANTARCTIC AREA**

May 1984 33 p

(PB85-107944; NESDIS-ENVIRON-INVENTORY-1) Avail: NTIS HC A03/MF A01 CSCL 05B

Geophysical data; Meteorological data; Oceanographic data; Glaciology data and information are contained. GRA

**N85-15244#** Joint Publications Research Service, Arlington, Va. **DEVELOPMENT OF RADAR TO MEASURE SEA ICE MERITS PRIZE NOMINATION Abstract Only**

Y. KOBZAREV /In its USSR Rept.: Earth Sci. (JPRS-UES-84-007) p 147 10 Dec. 1984 Transl. into ENGLISH from Izv. (Moscow), 1 Sep. 1984 p 3

Avail: NTIS HC A08

Research began with sea ice, for which field experiments were conducted to determine the optimum shape of the sounding signal. An original method was proposed which makes it possible to overcome the contradiction between the permissible value of radio-wave attenuation in sea ice and the possibility of distinguishing the top and bottom surfaces of ice cover separately. Onboard aircraft apparatus which was developed has begun to be used extensively for ice reconnaissance in various regions of the Arctic and on inland bodies of water of our country. The schematic concept for the method of receiving and processing signals was worked out, and an aircraft instrument for remote measurement of the thickness of sea ice was developed. The new remote measuring method was developed into ice reconnaissance and aerial surveying for ice-measurement purposes.

B.G.

## 06

## HYDROLOGY AND WATER MANAGEMENT

Includes snow cover and water runoff in rivers and glaciers, saline intrusion, drainage analysis, geomorphology of river basins, land uses, and estuarine studies.

**A85-10185#**

### **COMPATIBILITY OF PRESENT HYDROLOGIC MODELS WITH REMOTELY SENSED DATA**

L. E. LINK (U.S. Army, Engineer Waterways Experiment Station, Vicksburg, MS) /In: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 133-153. refs

Current and potential use of remotely sensed data in hydrological models (HM) is discussed. The history of HMs is reviewed, and the kinds and quality of data required are shown in a table. The remote sensing (RS) of meteorological conditions, watershed physical descriptors, and hydrological process parameters is described in detail; the HM parameters not accessible to RS are indicated; and the impact of improved sensors on the quality and availability of each type of HM input data is assessed. It is argued that current HMs are inadequately adapted to the RS data available, so that the additional data RS provides have not led to significant improvements in HM accuracy. It is recommended that future HMs be made more RS-compatible by permitting the use of distributed data, the updating of process algorithms during and between events, and the realistic calibration of the HM with more diverse and frequent data.

T.K.

## 06 HYDROLOGY AND WATER MANAGEMENT

**A85-10201#**

### **LANDSAT MONITORING OF TEMPORAL HYDROLOGICAL VARIATIONS ON THE PILCOMAYO RIVER, 1972-1981**

W. G. BROONER (Earth Satellite Corp., Chevy Chase, MD) and C. M. VIOLA BINAGHI (Aeroterra, S. A., Buenos Aires, Argentina) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 399-407.

**A85-10202#**

### **ANALYSIS OF BHASKARA-II SAMIR DATA OVER HIMALAYAN REGION USING CLUSTERING TECHNIQUE**

R. SINGH (Post-Graduate College, Ghazipur, India) and N. K. VYAS (Indian Space Research Organization, Image Processing and Analysis Div., Ahmedabad, India) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 409-414. refs

Analysis of Bhaskara-II SAMIR data has been carried out for monitoring of snow covered area in the Himalayan region using clustering technique at three frequencies (19, 22 and 31 GHz). Well-defined clusters were formed separately in 19-22, 22-31 and 31-19 GHz microwave brightness temperature. Consequently, characteristic microwave signatures were obtained for a variety of snow cover surfaces. From the available maps and Bhaskara TV imagery the various types of surface covers in the study area are identified and delineated. Thus, a correspondence is established between the surface covers and the clusters obtained during the analysis. It is found that clustering method works well and is capable of classifying and demarcating the broad categories of surface covers like snow and ice. Author

**A85-10203#**

### **AIRBORNE GAMMA RADIATION DATA USED TO ASSESS SNOW WATER EQUIVALENT OVER THE LAKE SUPERIOR BASIN**

R. L. GAUTHIER (U.S. Army, Corps of Engineers, Detroit, MI), T. R. CARROLL (NOAA, Office of Hydrology, Silver Spring, MD), and J. E. GLYNN (Environment Canada, National Hydrology Research Institute, Ottawa, Canada) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 415-424. refs

**A85-10205#**

### **DEVELOPMENT OF A REMOTE SENSING BASED CONTINUOUS STREAMFLOW MODEL**

J. R. GROVES and R. M. RAGAN (Maryland, University, College Park, MD) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 447-456. refs

The potential of space platform remote sensing to provide data for the synthesis of continuous hydrologic processes is rapidly advancing, but applications are limited by the absence of models designed to accept the newly available or anticipated remotely sensed data. This paper describes the development of the structure and the testing program for a physically based continuous streamflow model specifically designed to incorporate information obtained from space platform sensor systems. The linkage and operating concepts are similar to those of the established Stanford Watershed Model family but the parameters of the proposed model are more physically based and optimized to interface with current and anticipated remote sensing capabilities. All input data, both satellite and ground based, are incorporated into the model through a grid cell geographic information system. Author

**A85-10210#**

### **THE USE OF LANDSAT DATA FOR PREDICTING SNOWMELT RUNOFF IN THE UPPER SAINT JOHN RIVER BASIN**

C. J. MERRY, T. PANGBURN (U.S. Army, Cold Regions Research and Engineering Laboratory, Hanover, NH), and M. S. MILLER (M/A-COM Sigma Data, Inc., New York, NY) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 519-533. Army-sponsored research. refs

**A85-10212#**

### **THE APPLICABILITY OF TIROS-N/NOAA ADVANCED VERY HIGH RESOLUTION RADIOMETER DATA TO STUDIES OF LARGE ESTUARIES**

H. KARSZENBAUM, D. A. GAGLIARDINI (Consejo Nacional de Investigaciones Cientificas y Tecnicas, Centro Argentino de Estudios de Radiocomunicaciones y Compatibilidad Electromagnetica, Buenos Aires, Argentina), V. KLEMAS, F. DOMINGUEZ (Delaware, University, Newark, DE), and R. LEHECKIS (NOAA, National Environmental Satellite Service, Washington, DC) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 551-564. refs

Data from the Advanced Very High Resolution Radiometer (AVHRR) on board the TIROS-N/NOAA satellites have proven to be very useful in meteorological studies as well as snow cover, etc. In this paper it is shown that the AVHRR also constitutes a useful tool in the studies of large estuaries. First, a description of the satellite sensor system is presented. Then, the basic processes data have to undergo, such as image rectification and calibration, are described as well as the computer devices used to select and display the data. Finally a study case, the La Plata River, is presented to show that the information the AVHRR provides is useful to study surface sediment distribution patterns which appear in the visible channels as well as the characteristics of thermal signatures defined from the infrared spectral images. Author

**A85-10220#**

### **MICROCOMPUTERIZED IMAGE PROCESSING OF SATELLITE DATA FOR WATER QUALITY PURPOSES**

L. T. LINDELL (Statens Naturvardsverk; Uppsala, Universitet, Uppsala, Sweden) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 645-654. refs

In most industrialized countries the cost of monitoring water quality variables has risen dramatically during recent years due to the increased demand for information and high labor costs. In developing countries, there is an urgent need for cheap reliable surveys of vast areas, difficult to reach and sample manually, such as big reservoirs in arid and semiarid environments. Remote sensing with the aid of satellite sensing and microcomputerized image processing systems is well suited for such applications, both in developing and industrialized countries. This paper presents an inexpensive method for operational monitoring of water quality using a microcomputer system. The chromaticity mapping method has been used and it provides some advantages by normalizing for total radiance. This eliminates disturbances affecting all bands in the same proportion. Author

**A85-10249#**

### **GROUNDWATER INVESTIGATION IN WADI ARABA AREA EASTERN DESERT OF EGYPT, USING LANDSAT IMAGERY**

E. M. EL SHAZLY, M. M. RAKAIBY, and I. A. EL KASSAS (Nuclear Materials Corp.; Remote Sensing Center, Cairo, Egypt) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 1003-1013.

**A85-10287\*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**HYDROLOGICAL PLANNING STUDIES USING LANDSAT-4 THEMATIC MAPPER (TM)**

J. C. GERVIN, P. J. MULLIGAN (NASA, Goddard Space Flight Center, Greenbelt, MD), Y. C. LU, and R. F. MARCELL (Computer Sciences Corp., Silver Spring, MD) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 1403-1412. refs

NASA, in cooperation with the U.S. Army Corps of Engineers, is evaluating the capabilities of Landsat 4 Thematic Mapper (TM) data for environmental and hydrological applications. Attention is given to the results of studies conducted at the Clinton River Basin in Michigan and the eastern shore of the Chesapeake Bay in Maryland. In the former, the evaluation conducted was for the band combinations: (1) 2, 3, and 4; (2) 3, 4, and 5; (3) 3, 4, 5, and 6; and (4) all seven bands. In the latter case, Multispectral Scanner (MSS) and TM data were classified for combinations (1), (3) and (4). Wetland classification accuracy for the 7-band TM data in this study was found to be 9 percent higher than with MSS data, allowing more reliable and accurate monitoring. O.C.

**A85-11210\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**RESULTS OF AN IRRIGATED LANDS ASSESSMENT FOR WATER MANAGEMENT IN CALIFORNIA**

E. H. BAUER, J. D. BAGGETT (NASA, Ames Research Center, Moffett Field, CA), S. L. WALL, R. W. THOMAS, and C. E. BROWN (California, University, Berkeley, CA) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-22, Nov. 1984, p. 536-540.

Periodic assessment of existing and future demands for water within California is one responsibility of the California Department of Water Resources (CDWR). The California Irrigated Lands Assessment for Water Management Project represented a 5-year joint research effort between the NASA and the CDWR with technical support from the University of California (UC) at Berkeley and at Santa Barbara. The objectives were: (1) to develop and demonstrate procedures for providing highly precise, timely, estimates of irrigated area on a statewide basis using Landsat sensor data, and (2) to develop, through research with small demonstration sites, a procedure for the inventory and mapping of crop groups on a regional basis. Both manual and computer-assisted analyses were investigated. This paper highlights the statewide irrigated lands inventory where a procedure for statewide estimation of irrigated land using full frame Landsat MSS imagery and sampled ground data was successfully demonstrated. The statewide estimate of 3 990 112 hectares was within  $\pm$  or - 1.32 percent relative standard error at the 95-percent Confidence Interval, well within the design goal. This procedure represents a new capability for obtaining near-real time data on changes in agricultural water use throughout the state. Author

**A85-11567**

**EARTH - THE WATER PLANET**

A. HENDERSON-SELLERS and N. A. HUGHES (Liverpool, University, Liverpool, England) IN: Satellite sensing of a cloudy atmosphere: Observing the third planet. London, Taylor and Francis, 1984, p. 1-44. refs

Two important components of global energy transport are the latent heat flux that is determined by water phase changes, and oceanic circulation. Clouds, together with ice- and snow-covered areas, dominate planetary reflectivity; in addition, the height and amount of cloud cover is preeminently important in the control of the IR radiation emitted by the earth into space. Attention is presently given to the satellite remote sensing of water in each of its three phases and in the transitions between phases. Emphasis is given to the extreme or anomalous physical and chemical properties of water, and the energy transport role of the global hydrological cycle. Current and planned satellites whose operation concerns hydrological cycle and meteorological monitoring are

noted, as well as the import of comparative studies of surface and satellite observation-based cloud climatologies. O.C.

**A85-12049**

**A LANDSAT-ASSISTED STUDY OF THE AQUATIC AREAS OF THE LAKE KEMIJARVI REGION, NORTHERN FINLAND**

J. RAITALA, H. JANTUNEN (Oulu, University, Oulu, Finland), and S. HELLSTEN (Technical Research Centre of Finland, Oulu, Finland) Earth, Moon, and Planets (ISSN 0167-9295), vol. 31, Oct. 1984, p. 183-216. Research supported by the Foundation for Research of Natural Resources in Finland. refs

The aquatic complexes of the northern Finnish regulated lake, Kemijarvi, and its small adjoining natural lakes, are assessed in light of Landsat MSS imagery. Attention is given to the use of a computer-aided technique for surveying both natural and regulated aquatic areas, the recognition of different aquatic units and complexes defined by depth relations, bottom quality, vegetation coverage or flooding stage, and the representation of the lower limit of satellite data applicability in the mapping of small and complex areas. Computer-aided Landsat MSS remote sensing is found to be valuable in circumstances in which ground data collected from a small number of reference areas can be extrapolated so that it may apply to the lakes and aquatic areas within a single MSS frame. O.C.

**A85-12053\*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**IMPROVED CLASSIFICATION OF SMALL-SCALE URBAN WATERSHEDS USING THEMATIC MAPPER SIMULATOR DATA**

M. OWE and J. P. ORMSBY (NASA, Goddard Space Flight Center, Earth Survey Applications Div., Greenbelt, MD) International Journal of Remote Sensing (ISSN 0143-1161), vol. 5, Sept.-Oct. 1984, p. 761-770. refs

The utility of Landsat MSS classification methods in the case of small, highly urbanized hydrological basins containing complex land-use patterns is limited, and is plagued by misclassifications due to the spectral response similarity of many dissimilar surfaces. Landsat MSS data for the Conley Creek basin near Atlanta, Georgia, have been compared to thematic mapper simulator (TMS) data obtained on the same day by aircraft. The TMS data were able to alleviate many of the recurring patterns associated with MSS data, through bandwidth optimization, an increase of the number of spectral bands to seven, and an improvement of ground resolution to 30 m. The TMS is thereby able to detect small water bodies, powerline rights-of-way, and even individual buildings. O.C.

**A85-12974**

**SEASONAL DYNAMICS OF SUSPENDED-SEDIMENT PLUMES FROM THE TANA AND SABAKI RIVERS, KENYA - ANALYSIS OF LANDSAT IMAGERY**

W. H. BRAKEL (Loyola College, Baltimore, MD; Nairobi, University, Nairobi, Kenya) Remote Sensing of Environment (ISSN 0034-4257), vol. 16, Oct. 1984, p. 165-173. Research supported by Loyola College. refs

**A85-13740#**

**LANDSAT CLASSIFICATION OF THE HYDROLITTORAL AREAS OF THE BAY OF LIMINKA (GULF OF BOTHNIA, FINLAND)**

J. RAITALA (Oulu, University, Oulu, Finland), J. SIIRA (Joensuu, University, Joensuu, Finland), and H. ARKIMAA (Geological Survey of Finland, Espoo, Finland) Aquilo (ISSN 0570-5169), vol. 20, 1984, p. 14-23. Research supported by the Foundation for Research of Natural Resources in Finland and Academy of Finland. refs

The use of Landsat imagery in the study of the hydrolittoral regions of the Bay of Liminka (Gulf of Bothnia, Finland) is reviewed. The Landsat Multi-spectral Scanner (MSS) was used to map the distribution and botanical characteristics of different coastal areas by means of reflected radiation intensities. It is shown that Landsat can provide accurate classifications for the spectral characteristics of both areas with sparse and extensive vegetation. According to

differences in water depth and bottom quality which favor different plants. The agreement between Landsat classifications and a ground based survey of vegetation was found to be very good between depths of 0 to 2.5 m. Several examples of Landsat MSS images of the Bay of Liminka are provided. I.H.

### A85-16947

#### THE CONDITION OF SUBSATELLITE EXPERIMENTS ON BODIES OF WATER IN THE USSR AND HUNGARY [OPYT PROVEDENIIA PODSPUTNIKOVYKH EKSPERIMENTOV NA VODNYKH OB'EKTAKH SSSR I VNR]

I. F. BERESTOVSKII, A. A. GITELSON, D. SABO, and F. SILADI (Gosudarstvennyi Kamitet SSSR po Gidrometeorologii i Kontroliu Prirodnoi Sredy, Moscow; Gidrokhimicheskii Institut, Rostov-on-Don, USSR; Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest, Hungary) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), Sept.-Oct. 1984, p. 107-111. In Russian. refs

### A85-17333

#### COMPARATIVE UTILITY OF MICROWAVE AND SHORTWAVE SATELLITE DATA FOR ALL-WEATHER CHARTING OF SNOW COVER

D. ROBINSON, G. KUKLA (Lamont-Doherty Geological Observatory, Palisades, NY), K. KUNZI (Bern, Universitaet, Berne, Switzerland), and H. ROTT (Innsbruck, Universitaet, Innsbruck, Austria) Nature (ISSN 0028-0836), vol. 312, Nov. 29, 1984, p. 434, 435. Research supported by the Swiss National Science Foundation and Fonds zur Foerderung der Wissenschaftlichen Forschung of Austria. refs (Contract NSF ATM-82-00863)

An assessment is made of the usefulness of cloud- and solar illumination-independent microwave sensors in monitoring the extent and variation of snow cover in climatological and hydrological studies. The charting of hemispherical snow coverage by microwave was not feasible until high spatial resolution and multiple channel capabilities were combined in the Scanning Multichannel Microwave Radiometer (SMMR) of the Nimbus-7 satellite, launched in 1978. A comparison is presently conducted of SMMR data with shortwave images obtained over Asia, in order to evaluate the justification of efforts toward the use of microwave sensors in the automated charting of seasonal snow cover under all weather conditions. Agreement is noted between the two methods in about 75 percent of the tested points. O.C.

### A85-17500\*

#### National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

#### RESULTS OF AN IRRIGATED LANDS ASSESSMENT FOR WATER MANAGEMENT IN CALIFORNIA

E. H. BAUER, J. D. BAGGETT (NASA, Ames Research Center, Moffett Field, CA), S. L. WALL, R. W. THOMAS, and C. E. BROWN (California, University, Berkeley, CA) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 4 p.

Results of a statewide inventory of irrigated lands, under the NASA/CDWR (California Department of Water Resources) joint effort to develop procedures for providing high-precision, timely, irrigated acreage estimates using Landsat data, and for the inventory and mapping of crop groups on a regional basis, are presented. Ground samples were allocated for precision control, and the segments were randomly allocated to each land use stratum according to Neyman optimal rules. The statewide estimate obtained is shown to have a + or - 1.74 percent relative standard error and 99 percent confidence interval. For the hydrologic basins the design goal of + or 5 percent relative error was also met. L.T.

### A85-17501\*

#### Department of Agriculture, Beltsville, Md.

#### IMPLICATIONS OF COMPLETE WATERSHED SOIL MOISTURE MEASUREMENTS TO HYDROLOGIC MODELING

E. T. ENGMAN, T. J. JACKSON (U.S. Department of Agriculture, Hydrology Laboratory, Beltsville, MD), and T. J. SCHMUGGE (NASA, Goddard Space Flight Center, Greenbelt, MD) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 5 p.

A series of six microwave data collection flights for measuring soil moisture were made over a small 7.8 square kilometer watershed in southwestern Minnesota. These flights were made to provide 100 percent coverage of the basin at a 400 m resolution. In addition, three flight lines were flown at preselected areas to provide a sample of data at a higher resolution of 60 m. The low level flights provide considerably more information on soil moisture variability. The results are discussed in terms of reproducibility, spatial variability and temporal variability, and their implications for hydrologic modeling. Author

### A85-17521

#### REMOTE SENSING OF THE WATER EQUIVALENT OF SNOW COVER BY PASSIVE MICROWAVE SATELLITE OBSERVATIONS

M. T. HALLIKAINEN (Helsinki University of Technology, Espoo, Finland) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 4 p.

A new algorithm for mapping the water equivalent of snow cover, using the Nimbus-7 Scanning Multichannel Microwave Radiometer (SMMR), is tested on global and regional bases. The algorithm uses the difference in the brightness temperature between 18 and 37 GHz for snow-covered terrain. It was tested on forest, bogland, farmland, and water surface types in Finland over a period from February 15 to March 17, 1979. The total response of a resolution cell on the ground is divided into a summation of responses from the major surface types. The algorithm is noted to fit the observed water equivalent values with an accuracy of about 10 percent when applied to two different snow situations. The effect of introducing saturation on the standard deviation are evaluated for different dates. L.T.

### A85-17792

#### DEVELOPMENTS IN THE EVALUATION OF SMALL LAKE WATER QUALITY FROM DIGITAL LANDSAT MSS DATA, KUUSAMO, NORTHEAST FINLAND

J. RAITALA, H. JANTUNEN (Oulu, University, Oulu, Finland), and U. MYLLYMAA (Oulu, Water District Office, Oulu, Finland) Earth, Moon, and Planets (ISSN 0167-9295), vol. 31, Dec. 1984, p. 249-264. Research supported by the Foundation for Research of Natural Resources in Finland. refs

The water quality data collected on the ground by the Water District Office in Oulu was subjected to statistical analyses together with Landsat data to display a few interactions and the possibilities of exploiting remote sensing methods in water area surveying. Correlations between the Landsat data statistics and some water quality measurements were identified. The small size of the studied lakes does not allow any clear calibration to be made but there could be possibilities to develop remote sensing methods for the evaluation of environmental variables and the detection of productivity and the eutrophication stage. The remote sensing procedure could also be useful in portraying temporal variations within lakes as well as relative variations between lakes by classifying each lake on a pixel-by-pixel basis. Although the remote sensing method is not able to supersede ground truth information for lake studies, it has value in regions where many lakes are to be found within a restricted small area. Under these circumstances the collection of information on the ground for a small number of test lakes and the generalization of this data, machine-pressing remote sensing would result in considerably less field work and cost savings. Author

A85-18855

**THE CHOICE OF RELAXATION MODELS FOR THE DIELECTRIC PROPERTIES OF WATER IN REMOTE SENSING PROBLEMS**  
**[O VYBORE RELAKSATSIONNOI MODELI GIELEKTRICHESKIKH SVOISTV VODY DLIA ZADACH DISTANTSIONNOGO ZONDIROVANIYA]**

E. A. SHARKOV Moscow, Institut Kosmicheskikh Issledovaniy AN SSSR, 1983, 24 p. In Russian. refs

Current data processing techniques for satellite measurements of the dielectric properties of fresh water are analyzed and compared with numerical predictions based on Debye's (1931) approximate relaxation model. It is shown that the numerical model provides an adequate description of fresh water dielectric properties only down to a wavelength of 2 mm. In current versions of the model, approximate variations of the static constant and wave relaxation length with temperature correspond to values derived from remote sensing data. Discrepancies of the temperature approximations for the optical constant obtained in a number of studies are analyzed, and some methods for eliminating them are discussed. I.H.

**N85-11414\*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**MULTISPECTRAL IMAGING SCIENCE WORKING GROUP FOR HYDROLOGIC SCIENCE: EXECUTIVE SUMMARY Final Report**  
*In its* The Multispectral Imaging Sci. Working Group, Vol. 2 p 229-264 7 Sep. 1982 refs ERTS

Avail: NTIS HC A15/MF A01 CSCL 05B

The following working objectives were adopted: (1) define the current state of knowledge concerning the role of multispectral imaging science in hydrology; (2) identify critical areas where gaps in our knowledge limit opportunities for significant improvements in our understanding of the hydrologic processes; (3) evaluate the potential of multispectral imaging sciences as tools to close these gaps in knowledge; and (4) develop guidelines for a series of remote-sensing-based experiments that would help close these gaps in knowledge and, thereby, provide man with the improved scientific base necessary for better utilization of the world's water resource. The resulting documentation is intended to provide guidance for multispectral imaging programs in the hydrologic sciences with special emphasis on the visible and infrared (IR) wavelengths. Author

**N85-11428\*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

**WATER RESOURCES BY ORBITAL REMOTE SENSING: EXAMPLES OF APPLICATIONS [RECURSOS HIDRICOS POR SENSORIAMENTO REMOTO ORBITAL: EXEMPLOS DE APLICACOES]**

P. R. MARTINI, Principal Investigator Jun. 1984 36 p refs In PORTUGUESE; ENGLISH summary Sponsored by NASA Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS (E85-10015; NASA-CR-168572; NAS 1.26:168572; INPE-3157-RPE/457) Avail: NTIS HC A03/MF A01 CSCL 05B

Selected applications of orbital remote sensing to water resources undertaken by INPE are described. General specifications of Earth application satellites and technical characteristics of LANDSAT 1, 2, 3, and 4 subsystems are described. Spatial, temporal and spectral image attributes of water as well as methods of image analysis for applications to water resources are discussed. Selected examples are referred to flood monitoring, analysis of water suspended sediments, spatial distribution of pollutants, inventory of surface water bodies and mapping of alluvial aquifers. Author

**N85-14212#** Helsinki Univ. of Technology, Espoo (Finland). Radio Lab.

**THE FINNISH APPROACH TO MICROWAVE REMOTE SENSING OF SNOW**

M. I. HALLIKAINEN and M. E. TIURI *In* ESA EARSeL/ESA Symp. on Integrative Approaches in Remote Sensing p 81-87 Aug. 1984 refs

Avail: NTIS HC A17/MF A01

Dielectric measurements and modeling of snow and soils, development of an electronic snow wetness and density sensor, and calculations of the brightness temperature of snow-covered terrain are reviewed. Algorithms to retrieve the water equivalent of snow cover from Nimbus 7 SMMR data are described. The algorithms exploit the difference in brightness temperature between 18 and 37 GHz for snow covered terrain. Author (ESA)

**N85-14247#** South Carolina Univ., Columbia. Dept. of Geography.

**MULTISPECTRAL REMOTE SENSING OF INLAND WETLANDS IN SOUTH CAROLINA: SELECTING THE APPROPRIATE SENSOR**

J. R. JENSEN, M. HODGSON, E. J. CHRISTENSEN (Du Pont (E. I.) de Nemours and Co., Aiken, S.C.), H. E. MACKEY (Du Pont (E. I.) de Nemours and Co., Aiken, S.C.), and R. R. SHARITZ (Georgia Univ., Aiken, S.C.) 1984 22 p refs Presented at the Ann. Symp. on Machine Processing of Remotely Sensed Data, West Lafayette, Ind., 12-14 Jun. 1984 Submitted for publication (Contract DE-AC09-76SR-00001)

(DE84-013951; DP-MS-84-30; CONF-8406173-1) Avail: NTIS HC A02/MF A01

The utility of remote sensing for mapping both local (SRP) and regional wetlands was investigated. Particular observations of stream delta areas, (using aircraft multispectral scanner (MSS) imagery and large scale aerial photography), the SRP river swamp, (using aircraft MSS and LANDSAT thematic mapper imagery), and the Savannah River watershed (using LANDSAT MSS imagery) are discussed. DOE

**N85-14406\*#** South Dakota School of Mines and Technology, Rapid City.

**RAIN VOLUME ESTIMATION OVER AREAS USING SATELLITE AND RADAR DATA**

A. A. DONEAUD, J. R. MILLER, JR., L. R. JOHNSON, T. H. VONDERHAAR (Colorado State Univ., Fort Collins), and P. LAYBE (Colorado State Univ., Fort Collins) *In* NASA. Goddard Space Flight Center Global Scale Atmospheric Processes Res. Program Review p 203-209 Nov. 1984

Avail: NTIS HC A11/MF A01 CSCL 04B

The application of satellite data to a recently developed radar technique used to estimate convective rain volumes over areas on a dry environment (the northern Great Plains) is discussed. The area time integral technique (ATI) provides a means of estimating total rain volumes over fixed and floating target areas of the order of 1,000 to 100,000 km<sup>2</sup> for clusters lasting 40 min. The basis of the method is the existence of a strong correlation between the area coverage integrated over the lifetime of the storm (ATI) and the rain volume. One key element in this technique is that it does not require the consideration of the structure of the radar intensities inside the area coverage to generate rain volumes, but only considers the rain event per se. This fact might reduce or eliminate some sources of error in applying the technique to satellite data. The second key element is that the ATI once determined can be converted to total rain volume by using a constant factor (average rain rate) for a given locale. M.G.



## DATA PROCESSING AND DISTRIBUTION SYSTEMS

Includes film processing, computer technology, satellite and aircraft hardware, and imagery.

### **A85-10181\*# National Aeronautics and Space Administration. National Space Technology Labs., Bay Saint Louis, Miss. THE POTENTIAL OF EXPERT SYSTEMS FOR REMOTE SENSING**

D. W. MOONEYHAN (NASA, National Space Technology Laboratories, Earth Resources Laboratory, Bay Saint Louis, MS) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 51-64.

The use of expert systems for the interpretation of remote-sensing data is discussed. Expert-system architectures are described; the systems in use, under development, or proposed in various scientific and industrial fields are listed in a table; and three image-interpretation systems are briefly characterized. It is found that expert systems have the potential to perform repetitive interpretation of image data compiled from various remote-sensing satellites, especially to detect changes over time as in the case of deforestation. A system comprising an image interpreter, change interpreter, a cause interpreter, and a global data base is outlined and illustrated with a diagram. T.K.

### **A85-10186\*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif. MIDAS - A MICROCOMPUTER-BASED IMAGE DISPLAY AND ANALYSIS SYSTEM WITH FULL LANDSAT FRAME PROCESSING CAPABILITIES**

L. B. HOFMAN, W. K. ERICKSON (NASA, Ames Research Center, Moffett Field, CA), and W. E. DONOVAN (Informatics General Corp., Moffett Field, CA) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 157-172. refs (Contract NAS2-11555)

Image Display and Analysis Systems (MIDAS) developed at NASA/Ames for the analysis of Landsat MSS images is described. The MIDAS computer power and memory, graphics, resource-sharing, expansion and upgrade, environment and maintenance, and software/user-interface requirements are outlined; the implementation hardware (including 32-bit microprocessor, 512K error-correcting RAM, 70 or 140-Mbyte formatted disk drive, 512 x 512 x 24 color frame buffer, and local-area-network transceiver) and applications software (ELAS, CIE, and P-EDITOR) are characterized; and implementation problems, performance data, and costs are examined. Planned improvements in MIDAS hardware and design goals and areas of exploration for MIDAS software are discussed. T.K.

### **A85-10194# RADIOMETRIC PERFORMANCE OF THE THEMATIC MAPPER**

J. L. ENGEL, J. C. LANSING, JR., D. G. BRANDSHAFT, and B. J. MARKS (Santa Barbara Research Center, Goleta, CA) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 293-317.

This paper evaluates the radiometric performance of the TM through analyses of data from orbit, ground truth, and prelaunch test data. Results show that relative gain variations among channels in the reflective spectral bands had an average peak-to-peak value of 0.36 percent over a 3-month period. The variations are apparently uncorrelated with scene spectral features. Thermal band frequency histograms yield relative gains and offsets and are also used to

destrispe images. These values together with calibration data and atmospheric parameters calculated from sonde data yield a temperature estimate for an area of Lake Erie of 21 C to 27 C, compared to 21 C shown in local records. Part of this area was used to calculate noise equivalent temperature difference, which was 0.10 K at 300 K. The relative size of some quantizer steps was estimated from frequency histograms. Author

### **A85-10195\*# THEMATIC MAPPER GEOMETRIC CORRECTION PROCESSING**

E. P. BEYER (General Electric Co., Space Div., Valley Forge, PA) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 319-334. (Contract NAS5-25300)

The Thematic Mapper Image Processing System is described from the point of view of geometric correction. The system performance requirements are discussed, and the Landsat-D flight segment is described. The ground processing and overall geometric system performance is addressed. Those aspects of the Thematic Mapper Image Processing System that differ significantly from those of the MSS System are emphasized. C.D.

### **A85-10196# LIMITATIONS IN THE USE OF LANDSAT IMAGES FOR MAPPING AND OTHER PURPOSES IN SNOW- AND ICE-COVERED REGIONS - ANTARCTICA, ICELAND, AND CAPE COD, MASSACHUSETTS**

J. G. FERRIGNO and R. S. WILLIAMS, JR. (U.S. Geological Survey, Reston, VA) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 335-355. refs

### **A85-10216# CATEGORISATION OF MULTISPECTRAL DATA USING BINARY TREE CLASSIFIER**

A. D. KULKARNI (National Remote Sensing Agency, Secunderabad, India) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 609-615.

The advantage with the tree classifier over the single stage classifier is accuracy and computer efficiency. In this paper, an algorithm for a binary tree classifier has been developed and implemented. The basic concerns of the binary tree classifier are separation of two groups of classes, among the training samples at each nonterminal node and the choice of the subset of features which is most effective in separating these two groups of classes. As an example, a binary tree structure for Landsat data (4 bands) has been evaluated. The subsets of features to be used at each nonterminal node are obtained. Author

### **A85-10217# TEXTURE CLASSIFICATION REALIZED BY USE OF BILINEAR SPATIAL FILTER**

S. TSUTSUMI, K. TAKEMURA, and K. NAKATSUKA (Kyoto Institute of Technology, Kyoto, Japan) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 617-626. refs

This paper is concerned with a texture classification technique for image data realized by use of a bilinear spatial filter and a subsequent smoothing filter. Computer simulation results show that this technique results in an unsupervised classification for the nontrivial case. In reality, preprocessing for normalizing variance is necessary, since the variance differences are additionally reflected on the effect for the texture classification. Its application to Landsat data (band 7) has been shown. Author



A85-10219#

**FAST TWO-DIMENSIONAL FILTERING OF THERMAL SCANNER DATA WITH ONE-DIMENSIONAL ESTIMATION**

M. EHLERS (Hannover, Universitaet, Hanover, West Germany) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 635-643. refs

Thermal scanner imagery is often disturbed by 'scan-line-noise', especially over homogeneous areas like water surfaces. Common spatial filter techniques like 'moving average' or 'median filtering' are not sufficient. Also frequency domain filtering is not an optimal way for noise reduction. For this purpose a special digital filter, the scanner-regression-filter (SRF) for scanner imagery, was developed. This filter is derived from the assumption that scan-line-noise is column independent so that two-dimensional filtering can be reduced to a one-dimensional problem. The SRF method is compared to common techniques and shows best results. SRF together with atmospheric correction achieves temperature accuracies of 0.1 K. Author

A85-10234\*# Saskatchewan Univ., Saskatoon.

**LANDSAT IMAGE REGISTRATION - A STUDY OF SYSTEM PARAMETERS**

A. G. WACKER (Saskatchewan, University, Saskatoon, Canada), R. D. JUDAY (NASA, Johnson Space Center, Houston, TX), and R. H. WOLFE, JR. (IBM Thomas J. Watson Research Center, Yorktown Heights, NY) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 815-825. refs

Some applications of Landsat data, particularly agricultural and forestry applications, require the ability to geometrically superimpose or register data acquired at different times and possibly by different satellites. An experimental investigation relating to a registration processor used by the Johnson Space Center for this purpose is the subject of this paper. Correlation of small subareas of images is at the heart of this registration processor and the manner in which various system parameters affect the correlation process is the prime area of investigation. Parameters investigated include preprocessing methods, methods for detecting successful correlations, fitting a surface to the correlation patch, fraction of pixels designated as edge pixels in edge detection and local versus global generation of edge images. A suboptimum search procedure is used to find a good parameter set for this registration processor. Author

A85-10238#

**CONTEXTUAL CLASSIFICATION OF MULTISPECTRAL IMAGE DATA USING COMPOUND DECISION THEORY**

J. C. TILTON (Computer Sciences Corp., Silver Spring, MD) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 863-871. refs

Present operational multispectral classification algorithms are handicapped by their lack of utilization of spatial information. This lack will become more and more of a handicap at the finer spatial resolutions offered by the newer earth resources observation satellites. Recent studies have demonstrated the effectiveness of a contextual classifier that combines spatial and spectral information employing a general statistical approach. This algorithm exploits the tendency of certain ground-cover classes to occur more frequently in some spatial contexts than in others. The present paper explores several modifications to the algorithm designed to reduce execution time. Also examined is an implementation of the algorithm on the Massively Parallel Processor (MPP) which has an ideal speed-up factor of 4096. Author

A85-10239#

**THE EFFECTS OF SOLAR INCIDENCE ANGLE OVER DIGITAL PROCESSING OF LANDSAT DATA**

E. M. L. M. NOVO (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, Sao Paulo, Brazil) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 873-882. Previously announced in STAR as N84-10641. refs

A technique to extract the topography modulation component from digital data is described. The enhancement process is based on the fact that the pixel contains two types of information: (1) reflectance variation due to the target; (2) reflectance variation due to the topography. In order to enhance the signal variation due to topography, the technique recommends the extraction from original LANDSAT data of the component resulting from target reflectance. Considering that the role of topographic modulation over the pixel information will vary with solar incidence angle, the results of this technique of digital processing will differ from one season to another, mainly in highly dissected topography. In this context, the effects of solar incidence angle over the topographic modulation technique were evaluated. Two sets of MSS/LANDSAT data, with solar elevation angles varying from 22 to 41 deg were selected to implement the digital processing at the Image-100 System. A secondary watershed (Rio Bocaina) draining into Rio Paraiba do Sul (Cao Paulo State) was selected as a test site. The results showed that the technique used was more appropriate to MSS data acquired under higher Sun elevation angles. Topographic modulation components applied to low sun elevation angles lessens rather than enhances topography. M.G.

A85-10244\*# Environmental Research Inst. of Michigan, Ann Arbor.

**COMPARISON OF ATMOSPHERIC CORRECTION ALGORITHMS FOR THE COASTAL ZONE COLOR SCANNER**

F. J. TANIS (Michigan, Environmental Research Institute, Ann Arbor, MI) and S. C. JAIN (MONITEQ Ltd., Concord, Ontario, Canada) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 923-935. refs  
(Contract NAS3-22892)

Before Nimbus-7 Coastal Zone Color Scanner (CZC) data can be used to distinguish between coastal water types, methods must be developed for the removal of spatial variations in aerosol path radiance. These can dominate radiance measurements made by the satellite. An assessment is presently made of the ability of four different algorithms to quantitatively remove haze effects; each was adapted for the extraction of the required scene-dependent parameters during an initial pass through the data set. The CZCS correction algorithms considered are (1) the Gordon (1981, 1983) algorithm; (2) the Smith and Wilson (1981) iterative algorithm; (3) the pseudospectral depth method; and (4) the residual component algorithm. O.C.

A85-10251\*# Computer Sciences Corp., Silver Spring, Md.

**IMAGE SHARPENING FOR MIXED SPATIAL AND SPECTRAL RESOLUTION SATELLITE SYSTEMS**

W. A. HALLADA (Computer Sciences Corp., Silver Spring, MD) and S. COX (NASA, Goddard Space Flight Center, Greenbelt, MD) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 1023-1032. refs

Two methods of image sharpening (reconstruction) are compared. The first, a spatial filtering technique, extrapolates edge information from a high spatial resolution panchromatic band at 10 meters and adds it to the low spatial resolution narrow spectral bands. The second method, a color normalizing technique, is based on the ability to separate image hue and brightness components in spectral data. Using both techniques, multispectral images are sharpened from 30, 50, 70, and 90 meter resolutions. Error rates are calculated for the two methods and all sharpened resolutions.

## 07 DATA PROCESSING AND DISTRIBUTION SYSTEMS

The results indicate that the color normalizing method is superior to the spatial filtering technique. Author

### A85-10259#

#### USE OF SCALED PIXEL GRIDS IN IMAGE REGISTRATION VERIFICATION AND ANALYSIS

D. W. ECKHARDT, S. R. YOOL, and M. J. COSENTINO (California, University, Santa Barbara, CA) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 1117-1119.

The utility of scaled pixel grids for image registration verification and for image analysis is demonstrated. The construction of grids overlying orthophotoquads and corresponding topographic maps is discussed, and two applications of the technique are shown: the checking of registration of Landsat data to a 7.5 minute quadrangle, and the labelling of spectral clusters on a Landsat image. C.D.

### A85-10260#

#### DIGITAL COMPARISON AND CORRELATION TECHNIQUES FOR REMOTE SENSING IMAGES HAVING DIFFERENT SPACE RESOLUTION

V. CAPPELLINI (CNR, Istituto di Electronica and Istituto di Ricerca Sulle Onde Elettromagnetiche, Florence, Italy) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 1121-1124.

Some digital techniques are proposed to compare and correlate remote sensing images having different space resolution (as obtained from sensors aboard air crafts or satellites). Suitable digital filtering, spectral extrapolation and interpolation techniques are described. Considerations for the practical application of these techniques, in conjunction also with geometrical transformations, are developed, in particular to obtain integrated maps of the examined earth regions. Author

### A85-10266#

#### OPTIMIZING EDGE AND TEXTURE EDGE APPEARANCE MODEL FOR SAR IMAGES

E. E. TRIENDL (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Optoelektronik, Wessling, West Germany) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 1187-1191.

The optimizing edge appearance model for unsharp step edges is applied to preprocessed SAR images. Preprocessing consists of opening and closing operations followed by a low pass box filter, thus resulting in an unsharpened picture with a reasonable reduction of speckle noise. This picture is reduced by sampling every 5th row and column. Due to the noise immunity and super resolution capability of the edge operator, edges at the original resolution are obtained. Author

### A85-10268#

#### REDUCING THE SPECTRAL DIMENSION OF REMOTELY SENSED DATA AND THE EFFECT ON INFORMATION CONTENT

N. PENDOCK (Witwatersrand, University, Johannesburg; Anglo American Corp., Republic of South Africa), M. SEARS (Witwatersrand, University, Johannesburg, Republic of South Africa), and A. A. DE GASPARIS (Anglo American Corp., Republic of South Africa) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 1213-1222. refs

A digital technique for reducing the spectral dimension of a remotely sensed image is presented and demonstrated on a 4-band Landsat-MSS image. The commonly used Karhunen-Loeve principal-components reduction is explained, and a new approach based on the space-filling curve of Peano (1890) and providing

almost continuous one-to-one mapping is derived and implemented as a series of algorithms. The reduction of the 4-band image to a single band is shown in a series of photographs. T.K.

A85-10270\*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

COMPARISON OF EXISTING DIGITAL IMAGE ANALYSIS SYSTEMS FOR THE ANALYSIS OF THEMATIC MAPPER DATA W. C. LIKENS and R. C. WRIGLEY (NASA, Ames Research Center, Moffett Field, CA) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 1235-1242. refs

Most existing image analysis systems were designed with the Landsat Multi-Spectral Scanner in mind, leaving open the question of whether or not these systems could adequately process Thematic Mapper data. In this report, both hardware and software systems have been evaluated for compatibility with TM data. Lack of spectral analysis capability was not found to be a problem, though techniques for spatial filtering and texture varied. Computer processing speed and data storage of currently existing mini-computer based systems may be less than adequate. Upgrading to more powerful hardware may be required for many TM applications. Author

### A85-10271#

#### TEXTURE ANALYSIS ON SPOT SIMULATIONS

J. M. LAPORTE (Institut Geographique National, Saint-Mande, Val-de-Marne, France) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 1243-1252. refs

A textural method for interpreting SPOT remote sensing data is described. The method is based on the spacial arrangement of primitives and textural elements. To describe the spacial arrangement of the elements, a statistical approach and a structural approach are proposed. The method is evaluated statistically and found to be reasonably effective. Some of the possible applications of the method for processing remote sensing data from urban and forest environments are discussed. I.H.

### A85-10272#

#### THE FIRST YEAR OF OPERATION OF THE ALASKAN LANDSAT QUICK-LOOK SYSTEM

T. H. GEORGE, J. M. MILLER, and J. ZENDER-ROMICK (Alaska, University, Fairbanks, AK) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 1253-1263.

The University of Alaska has recently completed its first year of operation of a Quick-Look Landsat facility. This paper will briefly describe the system capabilities and provide several applications of near real-time Multispectral Scanner data. Examples will show the system capabilities of image enhancement and enlargement. Uses of Quick-Look imagery include monitoring sea ice and agricultural development, and documenting physical processes as they occur. Future plans include upgrading the system to include digital image storage and analysis capabilities. Author

### A85-10277#

#### ON THE ATMOSPHERIC POINT-SPREADING FUNCTION AND ITS EFFECT ON REMOTELY SENSED SPATIAL CHARACTERISTICS

R. K. KIANG (Lockheed-Electronics Image Processing Laboratory, Plainfield, NJ) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 1301-1309. refs

A Monte Carlo radiative transfer model developed previously is used to simulate the atmospheric point-spreading function (PSF). The PSF has a sharp center peak and two broad wings, composed of photons experiencing no collisions and those experiencing one or more collisions respectively. The spreading is proportional to

the aerosol loading. The measurement of Thematic Mapping Simulator flown over a rural area is convoluted with the atmospheric PSF. It is shown that its effect on overall spatial characteristics in remotely sensed data is insignificant. However, both textural and spectral properties are affected nonuniformly. Hence a reduction in classification accuracy is anticipated. Author

**A85-10282\*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**THE APPLICATIONS DEVELOPMENTAL DATA SYSTEM**

W. L. MOCARSKY and H. K. RAMAPRIYAN (NASA, Goddard Space Flight Center, Greenbelt, MD) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 1353-1362.

This paper describes a research and development system under development at NASA Goddard Space Flight Center (GSFC) for processing Landsat-4 Thematic Mapper (TM) data at high throughput rates. This system, called the Applications Developmental Data System (ADDS) is being developed with 2 objectives. First, during the initial year of Landsat-4 operations, ADDS provides an essential link in processing the TM images for image data quality assessment. The second objective is to demonstrate the ability to produce a radiometrically corrected TM image in 8 minutes and a geometrically correct image in 16 minutes. The processing rates currently achieved are presented. Author

**A85-10284\*#** Purdue Univ., Lafayette, Ind.

**EVALUATION OF LANDSAT-4 THEMATIC MAPPER AND MULTISPECTRAL SCANNER DATA QUALITY**

L. A. BARTOLUCCI, M. E. DEAN, C. D. MCGILLEM, P. E. ANUTA (Purdue University, West Lafayette, IN), and K. B. YU (Virginia Polytechnic Institute and State University, Blacksburg, VA) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 1373-1381.

(Contract NAS5-26859)

Landsat-4 image data quality was evaluated for test sites in Iowa and Illinois. Radiometric and geometric quality was tested and an applications evaluation was carried out using a cooling-pond thermal-mapping example. Geometric quality was found to be generally very good. Small errors were found in registration of the middle IR bands of the TM and the thermal IR band was found to be misregistered by one 120-meter pixel. Radiometric quality of the TM is excellent with only minor striping effects. Author

**A85-10285#**

**EARLY PROCESSING OF THEMATIC MAPPER DATA BY THE CANADA CENTRE FOR REMOTE SENSING**

T. BUTLIN and J. MURPHY (Canada Centre for Remote Sensing, Ottawa, Ontario, Canada) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 1383-1392. refs

In order to achieve a high degree of participation in NASA's Landsat-D Image Data Quality Analysis program, the Canada Centre for Remote Sensing has assembled a limited capability system with which to transcribe raw data from downlink high density tape to standard computer-compatible tape. Attention is given to the output products of this Thematic Mapper Transcription System (TMTS) which are required for the development and evaluation of radiometric and geometric correction algorithms as well as for Thematic Mapper evaluation. Relatively simple methods for the extension of TMTS functions toward the generation of bulk-corrected interim products are also presented. O.C.

**A85-10288\*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**GEOMETRIC ACCURACY ASSESSMENT OF LANDSAT-4 THEMATIC MAPPER P-TAPES**

N. A. BRYANT, A. L. ZOBRIST, and B. GOKHMAN (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 1413-1427. refs

(Contract NAS7-100; NAS7-918)

An analysis was performed on the P-format computer compatible tapes for the Landsat-4 Thematic Mapper (TM) scene 40109-15140 acquired November 2, 1982 over Washington, D.C. and environs. Three tests of sensor geometry were undertaken: (1) band-to-band registration, (2) line-to-line registration between swaths, and (3) geometric correction of sensor and spacecraft/ephemeris characteristics. The band-to-band and line-to-line registration was measured at one hundred pixel spacings along a line using the phase correlation image alignment method developed by Kuglin and Hines and adapted to a one-dimensional FFT correlation technique. The sensor and spacecraft geometric calibration analysis was checked by identifying 75 ground control points in the TM scene and on 1:24,000 topographic maps. A least squares fit of the gaps was computed and the vector offsets of the residuals was tabulated and plotted. Author

**A85-10602**

**RECOGNITION OF AREAL FEATURES FOR MAP-GUIDED IMAGE ANALYSIS**

H. RANZINGER and W. KROPATSCH (Graz, Forschungszentrum, Graz, Austria) IN: Applications of digital image processing; Proceedings of the Meeting, Geneva, Switzerland, April 19-22, 1983. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1983, p. 2-7. refs

(Contract DAJA37-80-C-0020)

The analysis of images can take advantage of existing knowledge; this may be denoted as data-driven or knowledge-based image analysis. One example is the use of topographic maps in the study of aerial imagery. A software system for object recognition using map-guidance is reported. Three algorithms have been developed to find areally extended objects in a digital image. Results can be applied to compare a map data base with an image; to monitor changes; to geometric and radiometric rectification; to support classification with training areas and other tasks. Author

**A85-10605**

**A STRUCTURED APPROACH TO SEGMENTATION OF AERIAL PHOTOGRAPHS**

J.-O. EKLUNDH (Kungl. Tekniska Hogskolan, Stockholm, Sweden) IN: Applications of digital image processing; Proceedings of the Meeting, Geneva, Switzerland, April 19-22, 1983. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1983, p. 21-27. Research supported by the Styrelsen for Teknisk Utveckling. refs

A structured approach to segmentation is described which in addition to the image uses simple and explicit knowledge concerning the geometry of objects and their spatial relations. The method is relaxation-like in that it operates with hypotheses which are given weights and does not use complex compatibilities. The approach comprises three processing levels: at the lowest level, hypotheses are formed concerning the material type of a pixel based on intensity and intensity variation; at the intermediate level, these hypotheses are refined into region hypotheses through the use of size and shape constraints; at the highest level, region labels are considered. At the present stage, the method is not used for complete segmentation; rather, it is a step for finding regions that can be matched with a map. B.J.

A85-10607

**IMAGE REGISTRATION THROUGH THE EXPLOITATION OF PERSPECTIVE INVARIANT GRAPHS**

J. F. GILMORE (Martin Marietta Aerospace, Signal Processing Dept., Orlando, FL) IN: Applications of digital image processing; Proceedings of the Meeting, Geneva, Switzerland, April 19-22, 1983. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1983, p. 55-63. refs

This paper describes two new techniques of image registration as applied to scenes consisting of natural terrain. The first technique is a syntactic pattern recognition approach which combines the spatial relationships of a point pattern with point classifications to accurately perform image registration. In this approach, a preprocessor analyzes each image in order to identify points of interest and to classify these points based on statistical features. A classified graph possessing perspective invariant properties is created and is converted into a classification-based grammar string. A local match analysis is performed and the best global match is constructed. A probability-of-match metric is computed in order to evaluate match confidence. The second technique described is an isomorphic graph matching approach called Mean Neighbors (MN). A MN graph is constructed from a given point pattern taking into account the elliptical projections of real world scenes onto a two dimensional surface. This approach exploits the spatial relationships of the given points of interest but neglects the point classifications used in syntactic processing. A projective, perspective invariant graph is constructed for both the reference and sensed images and a mapping of the coincidence edges occurs. A probability of match metric is used to evaluate the confidence of the best mapping. Author

A85-10610

**SEGMENTATION OF MULTITEMPORAL SIDE-LOOKING AIRBORNE RADAR (SLAR) IMAGES**

J. J. GERBRANDS and E. BACKER (Delft, Technische Hogeschool, Delft, Netherlands) IN: Applications of digital image processing; Proceedings of the Meeting, Geneva, Switzerland, April 19-22, 1983. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1983, p. 173-179. refs

This paper describes a procedure developed for the automated segmentation of multiple side-looking airborne radar (SLAR) images, i. e., the detection of the boundaries of agricultural fields. The segmentation procedure is based on a split-and-merge algorithm which may process up to three input images simultaneously. The input images must be in registration. A registration method is proposed which uses coarse structural descriptions of the input images as represented by attributed quartic picture trees (QPT). Author

A85-10813\*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**ATMOSPHERIC EFFECT ON SPATIAL RESOLUTION OF SURFACE IMAGERY**

Y. J. KAUFMAN (NASA, Goddard Space Flight Center, Laboratory for Atmospheric Sciences, Greenbelt, MD) Applied Optics (ISSN 0003-6935), vol. 23, Oct. 1, 1984, p. 3400-3408. refs

The combined sensor-atmosphere characteristics, defined by the modulation transfer function, are calculated and used to evaluate the apparent resolution of remotely sensed imagery as determined by those characteristics. The atmospheric effect on the upward radiance is described, and the reduction of the apparent spatial resolution due to the atmospheric effect is discussed. The atmospheric effect on remote sensing is compared to the effect of the sensor's pixel size, and results are presented for the maximum resolution that can be achieved in the presence of atmospheric blurring effects. C.D.

A85-11214\* Lockheed Engineering and Management Services Co., Inc., Houston, Tex.

**REGISTRATION OF A SYNTHETIC APERTURE RADAR IMAGE TO THEMATIC MAPPER IMAGERY FOR REMOTE SENSING APPLICATIONS**

S. S. YAO (Lockheed Engineering and Management Services Co., Inc., Houston, TX) and J. R. GILBERT (NASA, Johnson Space Center, Houston, TX) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-22, Nov. 1984, p. 557-563.

Multiple Thematic Mapper multitemporal acquisitions from Landsat and one synthetic-aperture radar acquisition from Seasat have been precisely registered using Johnson Space Center registration processors. The registered images have been output in the Universal Transverse Mercator projection. The procedure to accomplish such disparate data processing tasks and the registration accuracy evaluation are discussed. Author

A85-11215\* Boeing Co., Seattle, Wash.

**MODEL FOR OPTIMAL PARALLAX IN STEREO RADAR IMAGERY**

M. A. PISARUCK (Boeing Co., Seattle, WA), V. H. KAUPP, H. C. MACDONALD, and W. P. WAITE (Arkansas, University, Fayetteville, AR) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-22, Nov. 1984, p. 564-569. refs (Contract NAG9-3; JPL-956479)

Simulated stereo radar imagery is used to investigate parameters for a spaceborne imaging radar. Incidence angles ranging from small to intermediate to large are used with three digital terrain model areas which are representative of relatively flat, moderately rough, and mountainous terrain. The simulated radar imagery was evaluated by interpreters for ease of stereo perception and information content, and rank ordered within each class of terrain. The interpreter's results are analyzed for trends between the height of a feature and either parallax or vertical exaggeration for a stereo pair. A model is developed which predicts the amount of parallax (or vertical exaggeration) an interpreter would desire for best stereo perception of a feature of a specific height. Results indicate the selection of angle of incidence and stereo intersection angle depend upon the relief of the terrain. Examples of the simulated stereo imagery are presented for a candidate spaceborne imaging radar having four selectable angles of incidence. Author

A85-11216

**AN ALGORITHM FOR RADIOMETRIC AND GEOMETRIC CORRECTION OF DIGITAL SLAR DATA**

P. HOOGEBOOM (Centrale Organisatie voor Toegepast-Natuurwetenschappelijk Onderzoek, Fysisch Laboratorium TNO, The Hague, Netherlands), P. BINNENKADE (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands), and L. M. M. VEUGEN (Rijkswaterstaat, Delft, Netherlands) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-22, Nov. 1984, p. 570-576. refs

In The Netherlands an accurate SLAR system with digital data recording is used for measurements within the framework of the national microwave remote sensing research program. However, the images are disturbed by unwanted platform motions due to, e.g., turbulence at the low operating height (300-3000 m) of the SLAR system. An algorithm is developed for the geometric and radiometric correction of the radar data by means of aircraft attitude and position measurements. These measurements can be obtained from an Inertial Navigation System (INS) onboard the plane. Some additional information like the aircraft height and the measurement distance is obtained from the radar signal. The correction model is implemented in a computer program. The results clearly show an improvement of the image quality. Some specific problems that were encountered will be discussed and some results will be shown. Author

A85-11217

**PRELIMINARY RESULTS OF A SPECTRAL ANALYSIS OF SIMULATED COMPLEX PULSE RESPONSE HISTORY OF A SYNTHETIC APERTURE RADAR PIXEL**

K. TOMIYASU (GE Valley Forge Space Center, Philadelphia, PA) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-22, Nov. 1984, p. 577-581. refs

Images of a uniform scene produced with a synthetic aperture radar (SAR) frequently appear nonuniform. This phenomenon, called 'speckle', is attributed to the coherency of the radar signal and intra-pixel interferometry. Whereas speckle is usually associated with image contrast between adjacent pixels, the same type of contrast exists for one pixel between adjacent azimuthal looks (heading angles). A pixel in a terrestrial scene typically contains numerous scatterers and the phase and amplitude of the reflected radar signal generally varies from pulse to pulse due to intra-pixel interference. This variation in complex response history has been previously simulated by a computer program. In the present effort, the complex response history of a pixel with few scatterers is analyzed by a complex Fast Fourier Transform algorithm. After removing the phase centroid bias and mean phase slope from the original phase history, preliminary results indicate that the spectral responses show correlation with sub-pixel texture when there are one or two dominant scatterers in the pixel for a particular azimuth look. This textural information may be helpful in selecting the optimum resolution and number of azimuth looks for SAR imaging. Author

A85-11218\* Arkansas Univ., Fayetteville.

**SAR IMAGE ENHANCEMENT VIA POST-CORRELATION SIGNAL PROCESSING**

N. D. MATTHEWS, V. H. KAUPP, W. P. WAITE, and H. C. MACDONALD (Arkansas, University, Fayetteville, AR) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-22, Nov. 1984, p. 582-585. refs (Contract NAG9-3; JPL-956479)

Seventeen interpreters ranked sets of computer-generated radar imagery to assess the value of post-correlation processing on the interpretability of SAR (synthetic aperture radar) imagery. The post-correlation processing evaluated amounts to a nonlinear mapping of the signal exiting a digital correlator and allows full use of signal bandwidth for improving the spatial resolution or for noise reduction. The results indicate that it is reasonable to hypothesize an optimal SAR presentation format for specific applications even though this study was too limited to be specific. Author

A85-12051

**DIGITAL MOSAIC OF THE NETHERLANDS FROM LANDSAT-MSS DATA IN NATURAL COLOUR**

W. VERHOEF and P. W. H. PETERI (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands) International Journal of Remote Sensing (ISSN 0143-1161), vol. 5, Sept.-Oct. 1984, p. 749-751.

A85-12523#

**INTERPRETATION OF THERMAL IR-IMAGERY USING MULTI-SPECTRAL AND MULTI-TEMPORAL INFORMATION**

S. R. J. AXELSSON (Linköping, Universitet; SAAB-Scania AB, Linköping, Sweden) IN: International Scientific Conference on Space, 23rd, Rome, Italy, March 24, 25, 1983, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1984, p. 349-358. refs

The numerical models and algorithms used to interpret thermal IR remote sensing data are described, with special emphasis on the multispectral/temporal approach. Several computational procedures for interpreting IR data are analyzed which take into account the statistical relationships between detected radiation and latent and sensible heat flux, surface moisture conductivity, and heat capacity in the upper soil layer. The applicability of finite-difference and multispectral/temporal models to vegetation is compared, and it is found that the multispectral/temporal models

provides more accurate data for both day and night thermal variations. I.H.

A85-12549#

**ERS-1 IDHT - AN INTELLIGENT SYSTEM FOR INSTRUMENT AND DATA MANAGEMENT IN REMOTE SENSING SATELLITES ENVIRONMENT**

C. BOCCATO and G. BOERCI (Si. El S.p.A., Laben Divisione, Milan, Italy) IN: International Conference on Space, 24th, Rome, Italy, March 22, 23, 1984, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1984, p. 181-190.

A general description of the ERS-1 IDHT (Intelligent Data Handling and Transmission) system with a block diagram is provided, and the data handling, recording, transmission, control, and autocheck functions are considered. It is noted that the IDHT functions will help to realize the best tradeoff between satellite energy and resources utilization and data collection/transmission. The availability of an intelligent data handling subsystem makes possible the best utilization of the collected data, allowing both a good satellite resources management and surveillance and the provision to ground of already formatted data. This solution avoids the need of data merging from different sources and speeds up the data analysis and interpretation activities. L.M.

A85-12972\*

Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**POTENTIALS FOR CHANGE DETECTION USING SEASAT SYNTHETIC APERTURE RADAR DATA**

M. L. BRYAN and J. CLARK (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) Remote Sensing of Environment (ISSN 0034-4257), vol. 16, Oct. 1984, p. 107-124. NASA-supported research. refs

The use of synthetic aperture radar (SAR) images for detecting change on the earth's surface is highly dependent on target orientation, azimuth angle, and sensor depression angle. SAR data can be used for change detection when consistency is maintained in radar wavelength, polarization, azimuth directions, and off-nadir depression angle. The interaction of these parameters and the imaged surface for change detection are shown in examples drawn from (1) Los Angeles, CA, (2) southern Florida, (3) Imperial Valley, CA, (4) a desert region west of Tucson, AZ, and (5) western Kansas. SAR imagery is used to emphasize the geometric form, and roughness, of the earth's surface. As changes in the roughness of the surface occur over time, temporal SAR images will indicate those differences. Several guidelines for change detection studies using imaging radar are derived from the examples. Author

A85-13295#

**SIMPLE METHOD FOR PRECISE GEOMETRIC CORRECTION OF DIGITAL IMAGE**

L. GAZDAG International Astronautical Federation, International Astronautical Congress, 35th, Lausanne, Switzerland, Oct. 7-13, 1984. 9 p. Research supported by the Foldmeresi Intezet. refs (IAF PAPER 84-ST-08)

The operating principles and sources of geometric distortion of satellite terrestrial-remote-sensing scanners are reviewed; a geometric-correction algorithm is described; and a number of correction polynomials are evaluated. The resulting set of procedures is applied to small-area Landsat MSS and Thematic Mapper images and shown to give results with precision equal to that of the map being used. T.K.

**A85-14842**

## **PATTERN RECOGNITION IN PHOTOGRAMMETRY, 1; SPECIALIST WORKSHOP, GRAZ, AUSTRIA, SEPTEMBER 27-29, 1983, SELECTED PAPERS**

F. LEBERL, ED. (Graz, Technische Universitaet, Graz, Austria) Workshop sponsored by the International Society of Photogrammetry and Remote Sensing, Technische Universitaet und Forschungszentrum Graz, U.S. Army, et al. Photogrammetria (ISSN 0031-8663), vol. 39, Sept. 1984, 103 p. For individual items see A85-14843 to A85-14848.

The status and future directions being taken in pattern recognition techniques for computer processing of remotely sensed images are explored. Attention is given to the detection and subpixel location of photogrammetric targets in digital images, interactive analysis of digital terrain elevation and surface feature data, and knowledge-based photointerpretation. Integrated methods for image segmentation are described, as are segmentation techniques for comparing images. Finally, consideration is devoted to interframe coding of moving image sequences. M.S.K.

**A85-14845**

## **KNOWLEDGE-BASED AERIAL PHOTO INTERPRETATION**

D. M. MCKEOWN, JR. (Carnegie-Mellon University, Pittsburgh, PA) (International Society of Photogrammetry and Remote Sensing, Technische Universitaet und Forschungszentrum Graz, U.S. Army, et al., Specialist Workshop on Pattern Recognition in Photogrammetry, Graz, Austria, Sept. 27-29, 1983) Photogrammetria (ISSN 0031-8663), vol. 39, Sept. 1984, p. 91-123. refs  
(Contract ARPA ORDER 3597; F33615-81-K-1539)

An overview is presented of work in two areas that are crucial towards the development of automated tools for aerial photo interpretation: large-scale spatial data-bases, and rule-based systems for photo interpretation. First, models for spatial database systems are described and requirements for database support for knowledge-based photo interpretation are outlined. Next, a brief description of the organization of MAPS, the Map-Assisted Photo interpretation System is provided. MAPS is a large integrated database system containing high-resolution aerial photographs, terrain, digitized maps and other cartographic products, combined with detailed three-dimensional descriptions of man-made and natural features in the Washington D.C. area. Finally, recent work in the area of rule-based systems for photo interpretation is discussed. The system, SPAM, consists of three major components: and image/map database, a collection of image processing tools, and a rule-based system whose domain of expertise is commercial airports. Author

**A85-14846**

## **INTEGRATION OF METHODS FOR THE SEGMENTATION OF AERIAL PHOTOGRAPHS**

W. KESTNER and C. RUMPLER (Forschungsgesellschaft fuer angewandte Naturwissenschaften, Forschungsinstitut fuer Informationsverarbeitung und Mustererkennung, Ettlingen, West Germany) (International Society of Photogrammetry and Remote Sensing, Technische Universitaet und Forschungszentrum Graz, U.S. Army, et al., Specialist Workshop on Pattern Recognition in Photogrammetry, Graz, Austria, Sept. 27-29, 1983) Photogrammetria (ISSN 0031-8663), vol. 39, Sept. 1984, p. 125-134. refs

Remotely sensed image segmentation (IS) is described in terms of the procedures employed and results obtained from using several segmentation schemes to enhance image information-carrying quality. Areas of interest (AOI) are identified in the original image and used for control of the IS. A value is assigned to each AOI to denote the level of processing. Pixels in neighboring regions are merged by pyramids of spots of lower level resolution, intensity threshold values, resolution thresholds, connected components within patches, satisfaction of contour continuity confidence values, or likeness levels. Bright, dark, and slope features are then examined in 7X7 pixel windows to study edge probabilities. The AOI is displayed as bright and dark feature regions. Confidence

thresholds are assigned to each region or line before adding them. Executive schemes are still required for decisions on which process should be applied to the image AOI at any one point in processing. M.S.K.

**A85-16550**

## **RELATIVE ELEVATION DETERMINATION FROM LANDSAT IMAGERY**

S. WANG (George Mason University, Fairfax, VA), R.M. HARALICK (Machine Vision International, Ann Arbor, MI), and J. CAMPBELL (Virginia Polytechnic Institute and State University, Blacksburg, VA) Photogrammetria (ISSN 0031-8663), vol. 39, Nov. 1984, p. 193-215. refs

In Landsat imagery, spectral and spatial information can be used to estimate a relative digital terrain model in mountainous areas. To do this, the mixed information of direct and indirect illumination, material reflectance, and topographic modulation in the original Landsat imagery must be first separated. From the direct and indirect illumination information, ridges and valleys can be determined. From the material reflectance information, big visible rivers can be detected. Finally, a relative elevation model can be generated by elevation growing. In elevation growing valley pixels are assigned increasing elevations as they become more distant from the rivers or other valley pixels already assigned an elevation. It also proceeds in a direction perpendicular to valleys climbing up to the ridges assigning elevations to any unassigned pixel. Author

**A85-16587\*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

## **AN ALGORITHM FOR COMPUTING THE NUMBER OF DISTINCT SPECTRAL VECTORS IN THEMATIC MAPPER DATA**

S. W. WHARTON (NASA, Goddard Space Flight Center, Earth Resources Branch, Greenbelt, MD) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-23, Jan. 1985, p. 67-71. refs

A computationally efficient method was developed to compute the number of distinct spectral vectors and their frequency of occurrence in Landsat-4 Thematic Mapper (TM) data. The algorithm first partitions the image into spectrally disjoint subsets and then computes the frequency distribution of distinct spectral vectors within each subset from a multidimensional histogram. The overall frequency distribution is tabulated by accumulating the results from each subset. The number of distinct spectral vectors could be used as a measure of potential storage compaction of alternate data representations for data compression, or as a measure of information content in the comparison of spectral band combinations and/or spatial resolutions for an image. Results from processing three 512 x 512 pixel Landsat-4 TM images and one Landsat-4 Multispectral Scanner (MSS) image are presented as examples. An algorithm for computing the frequency distribution of distinct spectral vectors in MSS data is given in the Appendix. Author

**A85-17495**

## **LANDSAT-4 IMAGE DATA QUALITY ANALYSIS FOR ENERGY-RELATED APPLICATIONS - PRELIMINARY RESULTS**

G. E. WUKELIC and H. P. FOOTE (Battelle Pacific Northwest Laboratories, Richland, WA) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 5 p. Research supported by the U.S. Department of Energy.

Research related to using digital remotely sensed data, such as Landsat, for energy and environmental applications has been in progress at the Department of Energy's Pacific Northwest Laboratory (PNL) for over a decade. Currently, a multilaboratory DOE program is being conducted to analyze and evaluate potential energy-related uses of the Landsat-4 thematic mapper (TM) data as part of NASA's Landsat-4 Image Data Quality Analysis (LIDQA) Program. This paper describes the intent and scope of the research effort, and initial results obtained to date from the analysis and review of a very limited number of TM data sets over selected



DOE sites. These results are mainly associated with the use of the unique thermal data being acquired by the TM. Author

**A85-17496\*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**IMPACT OF THEMATIC MAPPER SENSOR CHARACTERISTICS ON CLASSIFICATION ACCURACY**

D. L. WILLIAMS, J. R. IRONS, B. L. MARKHAM, R. F. NELSON, D. L. TOLL (NASA, Goddard Space Flight Center, Earth Resources Branch, Greenbelt, MD), R. S. LATTY (Maryland, University, College Park, MD), and M. L. STAUFFER (Computer Sciences Corp., Silver Spring, MD) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 9 p. Previously announced in STAR as N84-30410. refs

A three factor (spectral, spatial, and radiometric resolution), two level (TM and MSS) analysis of variance (ANOVA) approach allowed evaluation of the effects of each factor individually and in all possible combinations. Digital classification accuracy was used as the figure of merit. Nine study sites in Washington, DC, each of approximately 256 x 256 TM pixels, were randomly selected from the full scene for analysis. These results strongly suggest that the quantization level improvements and the addition of new spectral bands in the visible and middle IR regions (both afforded by the TM sensor design) can result in improved capabilities to accurately delineate land cover categories using a per point Gaussian maximum likelihood classifier. On the other hand, results indicate that the increase in spatial resolution to 30 m does not significantly enhance classification accuracy. The spatial result points to an inherent limitation of a per point classifier and to the need to improve data analysis techniques to handle high spatial resolution data. A.R.H.

**A85-17497\*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**THEMATIC MAPPER IMAGE QUALITY - PRELIMINARY RESULTS**

R. C. WRIGLEY, D. H. CARD, C. A. HLAVKA, W. C. LIKENS (NASA, Ames Research Center, Moffett Field, CA), F. C. MERTZ, and J. R. HALL (Technicolor Government Services, Inc., Moffett Field, CA) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 6 p. Previously announced in STAR as N83-33284.

Based on images analyzed so far, the band to band registration accuracy of the thematic mapper is very good. For bands within the same focal plane, the mean misregistrations are well within the specification, 0.2 pixels. For bands between the cooled and uncooled focal planes, there is a consistent mean misregistration of 0.5 pixels along-scan and 0.2-0.3 pixels across-scan. It exceeds the permitted 0.3 pixels for registration of bands between focal planes. If the mean misregistrations were removed by the data processing software, an analysis of the standard deviation of the misregistration indicates all band combinations would meet the registration specifications except for those including the thermal band. Analysis of the periodic noise in one image indicates a noise component in band 1 with a spatial frequency equivalent to 3.2 pixels in the along-scan direction. Author

**A85-17536  
LANDSAT-4 IMAGES OF THE SAN FRANCISCO REGION - RESULTS OF DIGITAL IMAGE ENHANCEMENT AND INFORMATION EXTRACTION**

R. BERNSTEIN and J. B. LOTSPIECH (IBM Palo Alto Scientific Center, Palo Alto, CA) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 6 p. refs

An analysis of Landsat-4 Thematic Mapper data has been conducted, with concentration on assessing the information

content, accuracy, and quality of the data. The number of bits per picture element (pixel) of the TM data compared with the older Multispectral Scanner data has been estimated. To demonstrate the feasibility of combining TM data with other digital data bases to enhance information extraction potential, images were successfully brought into registration both with digitized maps and with TM data acquired on a different date. Experiments have also been conducted with different image color assignments and the dimensionality of the data has been estimated. Author

**A85-17546**

**PERIODIC SUMMATION OF INFRARED IMAGES FROM METEOSAT-2**

K. O. ROESKA (ESA, European Space Operations Centre, Darmstadt, West Germany) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 2 p.

Images of the earth's surface can be rectified (i.e. geographically registered). Thus whole images, areas of interest or even pixels can be compared in time. This paper describes the features which can be found in images that have been constructed artificially by selecting the pixels from a sequence of rectified infrared images taken by Meteosat. Sequences of these artificial images demonstrate the seasonal fluctuation of temperature on the earth's surface. The data could be used to construct iso-temperature tables with a fine resolution in space for meteorological use. Author

**A85-17553\*** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**THE UTILITY OF CALIBRATION - LANDSAT 4 TM SIMULATOR DATA, PATRICK DRAW, WYOMING**

H. R. LANG (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 5 p. Research supported by the Geosat Committee, Inc. and NASA. refs

A novel calibration approach was used for Landsat 4 TM simulator data acquired at the Patrick Draw test site, Wyoming, where the 'true' reflectance spectrum for any pixel area cannot be practically determined because of mixing of spectral components. An empirically derived function was first applied to the scanner data to remove the brightness gradient due to directional scattering and surface geometry. Based on the observation that the distribution of scanner brightness values (DN) were Gaussian, the minimum, mean, and maximum DN for each band were extracted and plotted versus the similar percent reflectance values determined from a large representative collection of field reflectance data for the area. These plots provided linear transformations relating DN value to reflectance in each band. V.L.

**A85-17565\*** Boeing Co., Seattle, Wash.

**AN ANALYSIS OF SIMULATED STEREO RADAR IMAGERY**

M. A. PISARUCK (Boeing Co., Seattle, WA; Arkansas, University, Fayetteville, AR), V. H. KAUPP, H. C. MACDONALD, and W. P. WAITE (Arkansas, University, Fayetteville, AR) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 6 p. refs  
(Contract NAG9-3)

Simulated stereo radar imagery is used to investigate parameters for a spaceborne imaging radar. Incidence angles ranging from small to intermediate to large are used with three digital terrain model areas which are representative of relatively flat, moderately rough, and mountainous terrain. The simulated radar imagery was evaluated by interpreters for ease of stereo perception and information content, and rank order within each class of terrain. The interpreter's results are analyzed for trends between the height of a feature and either parallax or vertical

exaggeration for a stereo pair. A model is developed which predicts the amount of parallax (or vertical exaggeration) an interpreter would desire for best stereo perception of a feature of a specific height. Results indicate the selection of angle of incidence and stereo intersection angle depend upon the relative relief of the terrain. Examples of the simulated stereo imagery are presented for a candidate spaceborne imaging radar having four selectable angles of incidence. Author

## A85-17757

### OVERVIEW OF PEL IMAGE PROCESSING CAPABILITY

M. J. MCDONNELL, D. PAIRMAN, and A. D. W. FOWLER (Department of Scientific and Industrial Research, Physics and Engineering Laboratory, Lower Hutt, New Zealand) *International Journal of Remote Sensing* (ISSN 0143-1161), vol. 5, Nov.-Dec. 1984, p. 883-886.

The Remote Sensing Section of the Physics and Engineering Laboratory has developed a general purpose image processing system. An overview of the system is given here. Its primary use is the production of special purpose map products from multispectral imagery. Its capabilities include enhancement, rectification, mosaicking, map digitization, automatic relief shading, filtering, restoration, classification and film production. The data base includes images from the Landsat and CZCS multispectral scanner satellites, images from an eleven-band aircraft multispectral scanner, and a variety of digitized maps. Author

## A85-17763

### DETERMINATION AND CORRECTION OF THE RELATIVE SHIFT BETWEEN THE VISIBLE AND THERMAL INFRARED GOES SENSOR IMAGES

A. A. TSONIS (Department of the Environment, Atmospheric Environment Service, Downsview, Ontario, Canada) *International Journal of Remote Sensing* (ISSN 0143-1161), vol. 5, Nov.-Dec. 1984, p. 975-979. Research supported by the Department of the Environment.

A simple method for the correction of the relative shift between the visible and thermal infrared GOES sensor images is introduced. It makes use of the variance operator and the cross-correlation between two patterns. Results indicate that the proposed method is very promising. Author

## A85-17765

### ON THE CONCEPT OF SPECTRAL CLASS

J. A. RICHARDS and D. J. KELLY (New South Wales, University, Kensington, Australia) *International Journal of Remote Sensing* (ISSN 0143-1161), vol. 5, Nov.-Dec. 1984, p. 987-991. refs

Classification of remote sensing image data requires the multispectral domain to be segmented into distinct regions called spectral classes. These are related to the geometric character of the classifier and consequently have multidimensional spectral shapes that are different for parallelepiped, minimum distance and maximum likelihood classification. This is particularly significant for regions of multispectral space that are substantially continua with few discernible density maxima, as is frequently the case in practice. Author

## A85-18451

### A BINARY TREE FEATURE SELECTION TECHNIQUE FOR LIMITED TRAINING SAMPLE SIZE

M. J. MUASHER (University of Petroleum and Minerals, Dhahran, Saudi Arabia; Purdue University, West Lafayette, IN) and D. A. LANDGREBE (Purdue University, West Lafayette, IN) *Remote Sensing of Environment* (ISSN 0034-4257), vol. 16, Dec. 1984, p. 183-194. refs

In cases where there are larger numbers of features available than should be used for a given classification task, current practice is to arbitrarily pick the number of features to be used and then to use a feature selection algorithm to determine the specific feature subset to be used. An algorithm is presented that predicts the best feature dimensionality, taking into account the number of training samples. It is demonstrated that rather small training set sizes are still practical using these techniques. Several experiments

are presented to assess the algorithm's performance, and a binary tree classification procedure with two examples that utilize the algorithm is shown to demonstrate its usefulness. Author

## A85-18859

### CERTAIN PROBLEMS IN THE ACQUISITION OF SPATIAL REPRESENTATIVE DATA IN STUDIES OF THE EARTH FROM SPACE [NEKOTORYE PROBLEMY POLUCHENIIA PROSTRANSTVENNO-REPREZENTATIVNYKH DANNYKH V ZADACHAKH ISSLEDOVANIYA ZEMLI IZ KOSMOSA]

T. K. ISMAILOV, R. A. TAGIEV, L. IA. GAVENSKII, and M. D. ALIEV (Moscow, Institut Kosmicheskikh Issledovaniy AN SSSR, 1983, 30 p. In Russian. refs.

The selection of a mathematical criterion for the representativeness of environmental parameters in remote sensing studies is discussed. Attention is given to the need to increase the accuracy of interpolations of the standardized correlation function (CF) by the interposition of nodal points. The concept of a standard deviation from ideal representativeness is introduced and is defined in physical terms as the square of the variation coefficient. The combined effects of the constant square of the variation coefficient and measuring error on the accuracy of data for environmental parameters is determined. A complete list is presented of the optimized values for the deviation constant, as they are correlated with various nodal points of the CF. I.H.

## N85-11028\*# Intergraph Corp., Huntsville, Ala.

### LANDSAT DATA AND INTERACTIVE COMPUTER MAPPING

R. K. GRADY /in NASA. Marshall Space Flight Center 2nd Symp. on Space Industrialization p 103-109 Oct. 1984

Avail: NTIS HC A19/MF A01 CSCL 05B

The integration of image processing capabilities with interactive computer mapping systems is discussed. It is noted that the accomplishment of this integration will result in powerful geographic information systems which will enhance the applications of LANDSAT and other types of remotely sensed data in solving problems in the resource planning and management domain. M.G.

## N85-11398# National Physical Research Lab., Pretoria (South Africa).

### THE APPLICATION OF PRINCIPAL COMPONENTS ANALYSIS TO LANDSAT MSS DATA

M. LASSERRE, O. G. MALAN, and B. TURNER /in CSIR Seminar on Principal Components Anal. in the Atmospheric and Earth Sci. p 156-168 1983

Avail: NTIS HC A09/MF A01

The LANDSAT Multispectral Scanner (MSS) collects digital image data in four spectral bands. Only three of these can be displayed independently in image form in a three-dimensional colour space. Principal components analysis is therefore an obvious way of data reduction. The problems and possibilities of display of the original imagery and the principal components will be discussed with reference to practical applications. Author

## N85-11399# Witwatersrand Univ., Johannesburg (South Africa). Centre for Resource Ecology.

### REDUCING SPECTRAL DIMENSION OF REMOTELY SENSED DATA USING PRINCIPAL COMPONENTS ANALYSIS AND A PEANO SCANNING

N. PENDOCK and M. SEARS /in CSIR Seminar on Principal Components Anal. in the Atmospheric and Earth Sci. p 169-186 1983

Avail: NTIS HC A09/MF A01

Remotely sensed data are collected in several spectral wavebands over a region. A digital picture of high spectral dimension is costly in terms of storage and computer processing, and is difficult to display. The aim of principal components analysis (the Karhunen-Loeve transformation) of a remotely sensed scene is to find a lower spectral dimensional representation that accounts for the feature variance. The Karhunen-Loeve transformation of an image is compared with another spectral dimension-reducing technique - an inverse space-filling (Peano) curve. A 4-band



LANDSAT image is reduced to a black and white picture using the above techniques and is discussed. Author

**N85-11404\*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**THE MULTISPECTRAL IMAGING SCIENCE WORKING GROUP.**

**VOLUME 1: EXECUTIVE SUMMARY Final Report**

S. C. COX, ed. Washington 1 Sep. 1982 39 p Working groups held in Pasadena, Calif., San Antonio, and Silver Spring, Md., 1 Sep. 1982 Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS 3 Vol.

(E85-10001; NASA-CP-2260-VOL-1; NAS 1.55:2260-VOL-1)

Avail: NTIS HC A03/MF A01 CSCL 05B

Results of the deliberations of the six multispectral imaging science working groups (Botany, Geography, Geology, Hydrology, Imaging Science and Information Science) are summarized. Consideration was given to documenting the current state of knowledge in terrestrial remote sensing without the constraints of preconceived concepts such as possible band widths, number of bands, and radiometric or spatial resolutions of present or future systems. The findings of each working group included a discussion of desired capabilities and critical developmental issues. M.G.

**N85-11405\*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**THE MULTISPECTRAL IMAGING SCIENCE WORKING GROUP.**

**VOLUME 2: WORKING GROUP REPORTS Final Report**

S. C. COX, ed. Washington 1 Sep. 1982 336 p refs Meetings held in Pasadena, Calif., San Antonio, and Silver Spring, Md., 1982 Original contains imagery. Original photography may be purchased from EROS Data Center, Sioux Falls, S.D. 57198 ERTS 3 Vol.

(E85-10002; NASA-CP-2260-VOL-2; NAS 1.55:2260-VOL-2)

Avail: NTIS HC A15/MF A01 CSCL 05B

Summaries of the various multispectral imaging science working groups are presented. Current knowledge of the spectral and spatial characteristics of the Earth's surface is outlined and the present and future capabilities of multispectral imaging systems are discussed.

**N85-11415\*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**INFORMATION SCIENCE PANEL JOINT MEETING WITH IMAGING SCIENCE PANEL Final Report**

*In its* The Multispectral Imaging Sci. Working Group, Vol. 2 p 265-299 7 Sep. 1982 refs ERTS

Avail: NTIS HC A15/MF A01 CSCL 05B

Specific activity in information extraction science (taken to include data handling) is needed to: help identify the bounds of practical missions; identify potential data handling and analysis scenarios; identify the required enabling technology; and identify the requirements for a design data base to be used by the disciplines in determining potential parameters for future missions. It was defined that specific analysis topics were a function of the discipline involved, and therefore no attempt was made to define any specific analysis developments required. Rather, it was recognized that a number of generic data handling requirements exist whose solutions cannot be typically supported by the disciplines. The areas of concern were therefore defined as: data handling aspects of system design considerations; enabling technology for data handling, with specific attention to rectification and registration; and enabling technology for analysis. Within each of these areas, the following topics were addressed: state of the art (current status and contributing factors); critical issues; and recommendations for research and/or development. B.G.

**N85-11416\*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**A PROSPECTUS FOR THEMATIC MAPPER RESEARCH IN THE EARTH SCIENCES**

Jul. 1984 71 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS

(E85-10003; NASA-TM-86149; NAS 1.15:86149) Avail: NTIS HC A04/MF A01 CSCL 08B

Earth science applications of Thematic Mapper (TM) imagery are discussed. Prospective research themes are defined in a general sense in relation to the technical measurement capabilities of the TM and the various types of Earth information that can potentially be derived from multispectral TM imagery. An overview of the system developed to acquire and reduce TM data is presented. The technical capabilities of this system are presented in detail. The orbital performance of the TM sensor is described, based upon the analysis of LANDSAT 4 and 5 TM data collected to date. M.A.C.

**N85-11417\*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

**FUNDAMENTAL REMOTE SENSING SCIENCE RESEARCH PROGRAM. PART 1: STATUS REPORT OF THE MATHEMATICAL PATTERN RECOGNITION AND IMAGE ANALYSIS PROJECT**

R. D. HEYDORN Aug. 1984 44 p ERTS 2 Vol.

(E85-10004; NASA-TM-58260-PT-1; S-536-PT-1; NAS

1.15:58260-PT-1) Avail: NTIS HC A03/MF A01 CSCL 05B

The Mathematical Pattern Recognition and Image Analysis (MPRIA) Project is concerned with basic research problems related to the study of the Earth from remotely sensed measurement of its surface characteristics. The program goal is to better understand how to analyze the digital image that represents the spatial, spectral, and temporal arrangement of these measurements for purposing of making selected inference about the Earth. Author

**N85-11427\*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

**A SYSTEM FOR THE MANAGEMENT OF REQUESTS AT AN IMAGE DATA BANK M.S. Thesis [UM SISTEMA PARA GERENCIAMENTO DO ATENDIMENTO DE PEDIDOS A UM BANCO DE IMAGENS]**

J. L. DEBARROSAGUIRRE, Principal Investigator Jun. 1984 157 p refs In PORTUGUESE; ENGLISH summary Sponsored by NASA ERTS

(E85-10014; NASA-CR-168571; NAS 1.26:168571;

INPE-3151-TDL/168) Avail: NTIS HC A08/MF A01 CSCL 05B

An automated system was implemented to supersede existing manual procedures in fulfilling user requests made to a remote sensing data bank, concerning specifically LANDSAT imagery. The system controls the several production steps from request entry to the shipment of each final product. Special solutions and techniques were employed due to the severe limitations, in both hardware and software of the host minicomputer system. Author

**N85-11434\*#** Environmental Research Inst. of Michigan, Ann Arbor.

**STUDY ON SPECTRAL/RADIOMETRIC CHARACTERISTICS OF THE THEMATIC MAPPER FOR LAND USE APPLICATIONS Quarterly Status Technical Progress Report, 21 Mar. - 20 Jun. 1984**

W. A. MALILA, Principal Investigator and M. D. METZLER Aug. 1984 25 p refs ERTS

(Contract NAS5-27346)

(E85-10021; NASA-CR-174044; NAS 1.26:174044;

ERIM-164000-11-P; QSTPR-7) Avail: NTIS HC A02/MF A01 CSCL 08B

Progress under the LANDSAT-4 and 5 Image Data Quality Assessment program for the Thematic Mapper is described. An initial screening of LANDSAT-5 data is performed. Tools are developed to allow access to TIPS-format data. Analysis of scan direction related signal droop is resumed with detailed analysis of

## 07 DATA PROCESSING AND DISTRIBUTION SYSTEMS

nighttime data. A new mathematical model is developed to describe the effect. Coherent noise of a lower frequency than previously reported is discovered and analyzed. Coincident LANDSAT-4 TM and MSS data are analyzed to improve understanding of radiometric relationships between similar wavebands in the two sensors.

M.A.C.

**N85-12417\*#** Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

**LANDAT-4/5 IMAGE DATA QUALITY ANALYSIS Quarterly Progress Report, 10 Aug. - 9 Nov. 1984**

P. E. ANUTA 9 Nov. 1984 5 p refs ERTS

(Contract NAS5-26859)

(E85-10039; NASA-CR-174131; NAS 1.26:174131;

LARS-CR-110984) Avail: NTIS HC A02/MF A01 CSCL 08B

LANDSAT-4/5 data quality analysis was covered. Focus was on estimation of two-dimensional point-spread function estimation. A brief description is included. B.G.

**N85-13357\*#** Arizona Univ., Tucson.

**INVESTIGATION OF SEVERAL ASPECTS OF LANDSAT 4/5 DATA QUALITY Quarterly Progress Report**

R. C. WRIGLEY, Principal Investigator 20 Sep. 1984 10 p ERTS

(Contract NCC2-234)

(E85-10038; NASA-CR-174129; NAS 1.26:174129) Avail: NTIS HC A02/MF A01 CSCL 05B

A technique under development uses a zoom transfer scope to register the photograph of the target with digitally enlarged photographic hardcopy of the TM data using a visual fit to the area surrounding the target. The first attempt using the Sacramento Scene (44/33) of February 1, 1983 indicated that relief displacement in the aerial photography would cause large errors. A second attempt is in progress using the aero-triangulated scene centers which have no relief displacement. Being calculated points, the scene centers have somewhat larger absolute errors in geolocation, approximately 3 meters instead of 1.5 meters. The average TM effective instantaneous field of view (EIFOV) calculated from modulation transfer functions (MTFs) is 52.7 m. This is smaller than the 55 and 65 m EIFOVs reported earlier using noisy MTFs but larger than the EIFOVs from the San Mateo Bridge analysis which ranged from 44.5 to 50.9 m and averaged 47.6 m for the same TM scene. R.S.F.

**N85-14206#** Natural Environment Research Council, Swindon (England). Thematic Information Service.

**THE INTEGRATED USE OF DIGITAL CARTOGRAPHIC DATA AND REMOTELY SENSED IMAGERY**

D. R. CATLOW, R. J. PARSELL, and B. K. WYATT /in ESA EARSeL/ESA Symp. on Integrative Approaches in Remote Sensing p 41-46 Aug. 1984 refs

Avail: NTIS HC A17/MF A01

A technique to enable digital map data to be displayed and processed in combination with remotely sensed imagery is outlined. The exploitation of the technique in studying land cover change using multitemporal LANDSAT MSS imagery and small scale digital map data, is described. The approach involves vector data transfer followed by conversion of the cartographic data into a raster format, based on the I2S system. Encoded map data can be overlaid on the remotely sensed images, or can be used as direct input to modify and supervise the computer analysis of imagery.

Author (ESA)

**N85-14231#** Politecnico di Milano (Italy). Ist. di Topografia, Fotogrammetria e Geofisica.

**METRIC EVALUATION OF SAR-580 OPTICAL IMAGES FOR CARTOGRAPHIC PURPOSES**

G. TOGLIATTI and A. MORIONDO /in ESA EARSeL/ESA Symp. on Integrative Approaches in Remote Sensing p 251-255 Aug. 1984 refs

Avail: NTIS HC A17/MF A01

The planimetric errors of 358 points identifiable on the X-band of SAR-580 images were compared with a ground truth supplied

by aerial triangulation of a photogrammetric block. Remarkable systematic behavior found in flight and across directions were removed with analytical and stochastic computations. The initial errors, amounting to several tens of meters, are reduced to 6 m in flight and 5 m in slant direction. The quantitative analysis shows poor definition of details, houses and cultivation limits being very difficult to identify. Cartographic applications are severely hindered by systematic deformation, revision by difficult identification of features. Author (ESA)

**N85-14232#** National Board for Scientific and Technological Research, Lisbon (Portugal). Outer Space Portuguese Committee.

**REMOTE SENSING DATA IN SUPPORT OF CONVENTIONAL DATA**

M. M. LOUREIRO /in ESA EARSeL/ESA Symp. on Integrative Approaches in Remote Sensing p 259-261 Aug. 1984 refs

Avail: NTIS HC A17/MF A01

The use of remote sensing data in agriculture and forestry, environmental protection, and fisheries is discussed. The need for improved spatial resolution and systems reliability to enable remote sensing to meet cost benefit specifications is emphasized.

Author (ESA)

**N85-14239#** Joint Research Centre of the European Communities, Ispra (Italy).

**COMBINING HEAT CAPACITY MAPPING MISSION (HCMM) LANDSAT AND THEMATIC MAP INFORMATION INTO A**

**UNIQUE HIGH PRECISION MERGED MULTICHANNEL SYSTEM**

D. R. GALLIDEPARATESI, H. GOSSMANN (Freiburg Univ., West Germany), and M. LEHNER (DFVLR, Oberpfaffenhofen, West Germany) /in ESA EARSeL/ESA Symp. on Integrative Approaches in Remote Sensing p 303-309 Aug. 1984 refs

Avail: NTIS HC A17/MF A01

Interpretation of satellite surface temperature patterns for climatology by combining them with ground measurements and additional thematic information layers is discussed. Changes in surface temperature due to land use modification, influence of relief on the nighttime heat balance of forests, sensible heat flux and air filtering efficacy, substitution of phenological climate indicators by satellite thermal imagery, wind-induced horizontal heat movements within extended industrial areas and use of a radar image as a topographical underpin for the interpretation of the thermal satellite imagery are considered. Combining geophysical information obtained by satellite and conventional thematic maps into a high-precision digital multilayer data system appears to be a suitable methodological procedure for investigating climatology at subregional level, related to natural and anthropogenic heat movements and release. The use of remote sensing data as multisource space information in support of conventional data looks very promising for practical applications. Author (ESA)

**N85-15247\*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

**EXPERIENCES WITH DIGITAL PROCESSING OF IMAGES AT INPE [EXPERIENCIAS COM PROCESSAMENTO DIGITAL DE IMAGENS NO INPE]**

N. D. A. MASCARENHAS, Principal Investigator Oct. 1984 20 p refs In PORTUGUESE; ENGLISH summary Presented at Seminario Sobre Processamento de Sinais e Tratamento de Inform., Rio de Janeiro, 16 Oct. 1984 Sponsored by NASA ERTS

(E85-10045; NASA-CR-174189; NAS 1.26:174189;

INPE-3293-PRE/608) Avail: NTIS HC A02/MF A01 CSCL 09B

Four different research experiments with digital image processing at INPE will be described: (1) edge detection by hypothesis testing; (2) image interpolation by finite impulse response filters; (3) spatial feature extraction methods in multispectral classification; and (4) translational image registration by sequential tests of hypotheses. Author

## INSTRUMENTATION AND SENSORS

Includes data acquisition and camera systems and remote sensors.

**A85-10182\*#** National Aeronautics and Space Administration, Washington, D. C.

**FUTURE REMOTE SENSING INSTRUMENTS AND SYSTEMS**

D. R. BROOME, JR. (NASA, Washington, DC) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 65-73.

Scientific requirements for terrestrial remote-sensing satellites in the 1990's and instrument packages to meet them are discussed, summarizing the results of a preliminary study conducted by the NASA System Z Science and Mission Requirements Working Group. Major questions regarding atmospheric chemistry and circulation, global climate, ocean dynamics, biogeochemical cycles, ice-budget and hydrological cycles, continental geology, biomass dynamics, and land cover and use are listed along with the observational frequency and resolution necessary to answer them, and an instrument use matrix is presented. Large essentially permanent man-tended arrays of instruments serving multiple functions and linked to the users via advanced information-processing networks and (possibly including expert systems) are recommended, and a basic payload and two supplemental packages are outlined. T.K.

**A85-10193\*#** National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

**AN OVERVIEW OF LANDSAT-4 STATUS AND RESULTS**

V. V. SALOMONSON (NASA, Goddard Space Flight Center, Greenbelt, MD) and R. KOFFLER (NOAA, National Environmental Satellite and Data Information Service, Washington, DC) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 279-291. refs

Analyses of Landsat-4 satellite Thematic Mapper (TM) data indicate good spatial, spectral, and radiometric performance. Land cover features such as residential areas and field boundaries, as well as geomorphological features, are more sharply defined with the 30-m nominal resolution of the TM than with the Multispectral Scanner. The new TM spectral bands in the 1.6 and 2.2-micron regions are noted to be useful in the delineation of vegetation types and geological conditions involving hydrothermal alteration. O.C.

**A85-10253\*#** State Univ. of New York, Syracuse.

**DEPENDENCE OF NOAA-AVHRR RECORDED RADIANCE ON SCAN ANGLE, ATMOSPHERIC TURBIDITY AND UNRESOLVED CLOUD**

D. J. PIWINSKI, L. B. SCHOCH, M. J. DUGGIN (New York, State University, Syracuse, NY), V. WHITEHEAD, and E. RYLAND IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 1043-1053. refs

(Contract NAS9-16514)

Experimental evidence on the scan angle and sun angle dependence of radiance recorded by the Advanced Very High Resolution Radiometer (AVHRR) devices on the NOAA-6 and NOAA-7 satellites is presented. The effects of atmospheric turbidity at various scan angles is shown, and simulations of angular anisotropy and recorded radiance are compared with the recorded digital data from the AVHRR obtained over the Great Plains area of the US. Evidence is presented on the effects of unresolved cloud on the recorded radiance and vegetative indices from uniform, vegetative targets. C.D.

**A85-10262#**

**COMPARISON OF THE POTENTIAL OF BHASKARA-II TV AND LANDSAT MSS DATA FOR MAPPING OF DIFFERENT LAND FEATURES**

S. K. PATHAN and J. S. PARIHAR (Indian Space Research Organization, Space Applications Centre, Ahmedabad, India) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 1147-1155. refs

A comparative study is conducted of the potential value of the Bhaskara II satellite's TV data, which will be available in two spectral bands with approximately 1 sq m resolution, in view of the quality of the Landsat Multispectral Scanner data currently available. Attention is given to the discernibility of various land cover types for the cases of two different agroclimatic regions. It is found that, although coarser than Landsat data, the Bhaskara II TV can distinguish seven land cover classes: urban land, agricultural land, forest, water, barren land, snow, and wetland. O.C.

**A85-10274#**

**DIGITAL STEREO ENHANCEMENT OF LANDSAT-MSS DATA**

R. SIMARD (Canada Centre for Remote Sensing, Ottawa, Canada) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 1275-1281. refs

The stereoscopic acquisition of Landsat-MSS data is possible when two orbits overlap a common area. Since the maximum slant angle of the MSS is only 5.8 deg, the stereo effect is very small and almost imperceptible visually. Nevertheless, the parallax information due to the relief is present in these data and its evaluation by digital image analysis methods can be used to effectively improve the three-dimensional perception of such stereo pairs. A stereoscopic enhancement technique has been developed and tested. The methodology used to accentuate the stereo geometry is demonstrated using Landsat-MSS data acquired over two mountainous areas in Canada. Author

**A85-10290#**

**EXPERIMENTS ON RESAMPLING OF LOCALLY UNEQUALLY SPACED RS DATA AND RELATIVE RADIOMETRIC CORRECTION OF LINEAR ARRAY SENSOR DATA**

K. TSUCHIYA (Chiba University, Chiba, Japan), K. ARAI (National Space Development Agency of Japan, Tokyo, Japan), F. KOMURA, K. HOMMA, S. YAMAGATA (Hitachi, Ltd., Systems Development Laboratory, Kawasaki, Japan), and H. OTA (Hitachi, Ltd., Omika Works, Hitachi, Japan) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 1437-1446. refs

In response to the development of new sensors, new techniques to eliminate geometric and radiometric distortions of remotely sensed data become necessary. In this connection two experiments were made. The first was concerned with the resampling of locally unequally spaced RS data and the result revealed that the optimal resampling method varies in accordance with the magnitude of data spacing. The second was related to the relative radiometric correction of linear array sensor data. It was shown that the method based on the low pass filtering could successfully eliminate stripes which existed in the raw data. Author

**A85-10583\*** RCA Labs., Princeton, N. J.

**HIGH-DENSITY SCHOTTKY BARRIER IRCCD SENSORS FOR REMOTE SENSING APPLICATIONS**

H. ELABD (RCA Laboratories, Princeton, NJ), J. R. TOWER, and B. M. MCCARTHY (RCA Advanced Technology Laboratories, Camden, NJ) IN: Advanced infrared sensor technology; Proceedings of the Meeting, Geneva, Switzerland, April 18, 19, 1983. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1983, p. 91-100. NASA-supported research. refs

It is pointed out that the ambitious goals envisaged for the next generation of space-borne sensors challenge the

state-of-the-art in solid-state imaging technology. Studies are being conducted with the aim to provide focal plane array technology suitable for use in future Multispectral Linear Array (MLA) earth resource instruments. An important new technology for IR-image sensors involves the use of monolithic Schottky barrier infrared charge-coupled device arrays. This technology is suitable for earth sensing applications in which moderate quantum efficiency and intermediate operating temperatures are required. This IR sensor can be fabricated by using standard integrated circuit (IC) processing techniques, and it is possible to employ commercial IC grade silicon. For this reason, it is feasible to construct Schottky barrier area and line arrays with large numbers of elements and high-density designs. A Pd2Si Schottky barrier sensor for multispectral imaging in the 1 to 3.5 micron band is under development. G.R.

## A85-11566

### SATELLITE SENSING OF A CLOUDY ATMOSPHERE - OBSERVING THE THIRD PLANET

A. HENDERSON-SELLERS, ED. (Liverpool, University, Liverpool, England) London, Taylor and Francis, 1984, 358 p. For individual items see A85-11567 to A85-11574.

The present work on satellite-based cloud sensing discusses current and projected satellite missions, the nature of atmospheric radiation and its effect on satellite sensors, measurement of the earth's annual radiation budget (and the budget's relation to the seasonal cycle), satellite studies of regional and global climatologies, and the photochemistry of the troposphere. Also considered are the remote sensing of air pollution from satellites, vertical temperature sounding of the atmosphere, the determination of cloud fields, surface temperature and surface emissivity, atmospheric windows for cloud detection from satellites, atmospheric distortion effects in land surface sensing, the interaction between clouds and sea surface temperature, and the importance of cloud-cryosphere observation at high latitudes from satellites. O.C.

## A85-11572

### CLOUD IDENTIFICATION AND CHARACTERIZATION FROM SATELLITES

J. T. BUNTING and K. R. HARDY (USAF, Geophysics Laboratory, Bedford, MA) IN: Satellite sensing of a cloudy atmosphere: Observing the third planet. London, Taylor and Francis, 1984, p. 203-240. refs

Approaches to the detection of clouds from satellites are discussed, with emphasis on imaging sensors that respond to radiation in specific atmospheric windows. These sensors provide maximum information on cloud properties and their distribution in time and space, such as cloud variability, and can be used so that low as well as high clouds can be seen. For the shorter wavelength windows, the fact that sunlight is reflected renders sensing useful only in daytime. Longer wavelength windows sense thermal energy originating from the clouds, or their backgrounds, together with smaller contributions from the atmosphere itself. These windows may be used either diurnally or nocturnally. Millimeter and microwave frequency windows exhibit 90 percent transmittance from sea level to the satellite, and are sensitive to the larger water particles and raindrops. O.C.

## A85-11574

### CLOUD-CRYOSPHERE INTERACTIONS

A. M. CARLETON (Arizona State University, Tempe, AZ) IN: Satellite sensing of a cloudy atmosphere: Observing the third planet. London, Taylor and Francis, 1984, p. 289-325. refs

Attention is given to such satellite products as high resolution imagery in the visible and IR, as well as passive microwave data, that have been used to investigate the interaction between clouds and the cryospheres of both hemispheres. The features of major snow and ice satellite monitoring systems and the theory and practice of the derivation of climate dynamics data are noted, especially with respect to the newer, passive microwave systems. Emphasis is given to the difficulties involved in the identification of concurrent cryosphere/cloud variations using different sensors,

and to the resulting lack of studies in this area. The use of satellite imagery to derive synoptic climatological information on cyclonic activity in the vicinity of cryosphere boundaries, from pattern recognition of cloud vortex signatures, is noted to represent a useful substitute for climatological cloud cover data. O.C.

## A85-11814

### DETERMINATION OF THE CHARACTERISTICS OF OPTICAL REFLECTORS ON THE BASIS OF REMOTE-SENSING DATA [OPREDELENIE KHARAKTERISTIK OTRAZHATELEI OPTICHESKOGO IZLUCHENIIA PO REZUL'TATAM DISTANTSIONNOGO ZONDIROVANIYA]

I. F. PISAREVSKII (Kaliningradskoe Vysshie Voenno-Morskoe Uchilishche, Kaliningrad, USSR) Geodeziya i Aerofoto'emka (ISSN 0536-101X), no. 4, 1984, p. 93-98. In Russian. refs

The paper examines the possibility of using the directive gain of optical reflectors on the earth's surface to determine the surface-roughness characteristics of natural objects on the basis of spacecraft remote-sensing data. Formulas are obtained which can be used to solve certain inverse problems of remote sensing. In particular, the use of directive gain to determine the effective scattering surface of flat reflectors with different degrees of surface roughness is evaluated. B.J.

## A85-12536

### INTERNATIONAL CONFERENCE ON SPACE, 24TH, ROME, ITALY, MARCH 22, 23, 1984, PROCEEDINGS [CONVEGNO INTERNAZIONALE SULLO SPAZIO, 24TH, ROME, ITALY, MARCH 22, 23, 1984, ATTI]

Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1984, 202 p. In Italian, English, and French. For individual items see A85-12537 to A85-12550.

International cooperation in the area of satellite remote sensing is discussed with particular attention given to remote sensing activities in Italy with regard to cooperation with developing countries; earthquake studies in Egypt; and the use of Meteosat in the Italian Meteorological Service. Active microwave remote sensing systems are considered; the ERS-1 active microwave instrumentation, swath widening in spaceborne SAR, and remote sensing of ocean dynamics by satellite altimetry are covered. Finally, various other types of remote sensing techniques are examined, with consideration given to the Nigerian Radar Project, the FRONTIERS nowcasting system, and IROE mobile ground stations for receiving remote sensing data. L.M.

## A85-12537#

### REMOTE SENSING ACTIVITIES IN ITALY - OPPORTUNITIES FOR COOPERATION WITH DEVELOPING COUNTRIES

B. RATTI (Telespazio S.p.A., Rome, Italy) IN: International Conference on Space, 24th, Rome, Italy, March 22, 23, 1984, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1984, p. 15-24. refs

## A85-13049#

### BENEFITS OF A EUROPEAN DATA RELAY SATELLITE FOR AN OPERATIONAL REMOTE SENSING SATELLITE SYSTEM

K. G. LENHART (ESA, Darmstadt, West Germany) and J. N. DE VILLIERS (ESA, Noordwijk, Netherlands) International Astronautical Federation, International Astronautical Congress, 35th, Lausanne, Switzerland, Oct. 7-13, 1984. 12 p. (IAF PAPER 84-97)

The ESA Data Relay Satellite (DRS) program is discussed with reference to European earth observation plans, trends for system requirements for remote sensing missions, and the definition of a DRS baseline system. The DRS can make data available within its coverage zone in real time, permitting either centralized (and hence more economical) processing of data being relayed to one central processing station or decentralized processing if data are relayed to dedicated user processing facilities. It is concluded that a European DRS will offer considerable advantages in support of an operational remote sensing satellite system, the main ones being increased coverage, near real-time response, operational

simplification, and a considerable potential cost-saving for earth stations. L.M.

#### A85-13051#

##### THE FRENCH PAYLOAD ON BOARD TOPEX

J. P. AGUTTES and P. RAZONVILLE (Centre National d'Etudes Spatiales, Toulouse, France) International Astronautical Federation, International Astronautical Congress, 35th, Lausanne, Switzerland, Oct. 7-13, 1984. 9 p. (IAF PAPER 84-100)

In 1989, an Ariane booster will launch the NASA satellite designated 'TOPEX'. This spacecraft will carry two Centre National d'Etudes Spatiales oceanographic instruments: a radar altimeter of design similar to those of Seasat, using solid state amplification, and the radiopositioning instrument designated 'DORIS', which will conduct uplink Doppler measurements on signals transmitted from about 50 beacons located throughout the globe. O.C.

#### A85-13065#

##### THE RESULT OF ETS-3 VIDICON CAMERA

Y. YAMAMOTO and F. IMAI (National Space Development Agency of Japan, Tokyo, Japan) International Astronautical Federation, International Astronautical Congress, 35th, Lausanne, Switzerland, Oct. 7-13, 1984. 9 p. (IAF PAPER 84-115)

ETS-3 vidicon camera (VC) is an experimental earth observation sensor. The VC has been operating since November, 1982 and gained more than 40,000 images. The VC has three spectral bands and its resolution is about 437 m. As the VC exposes at intervals of 5 or 25 seconds, 80 percent maximum overlap images are available. The tideland, the scattering of the river, and the floating ice are monitored from the VC images. The height of cloud is calculated by making use of the VC image overlap. A laser beam transmitted from the ground at night was detected on the VC image as a small spot. It is proved that the VC images are useful for oceanography and meteorology. The ETS-3 attitude is also estimated from the VC images. Roll, pitch and yaw angle are monitored through one year operation. Author

#### A85-14428

##### REPORT ON CRESTWOOD STUDY PANEL ON EARTH RESOURCES

I. S. HAAS (Cargill, Inc., Minneapolis, MN) and R. BALDWIN (General Electric Co., Fairfield, CT) IN: EASCON '83; Proceedings of the Sixteenth Annual Electronics and Aerospace Conference and Exposition, Washington, DC, September 19-21, 1983. New York, Institute of Electrical and Electronics Engineers, 1983, p. 11-15.

The results of a study of potential Space Station earth resources remote sensing applications are summarized. A need for more effective systems of processing, handling and delivering remote sensing data was identified. Whether the processing facilities should be on-board or earth-based is a matter for further investigations. Hardware requirements include photographic, solid-state array, passive microwave, and high resolution passive imaging devices, SAR active imaging, and gravity, magnetometer, and VLBI/laser ranging sensors. A near-polar, sun-synchronous orbit was indicated. To achieve the projected goals, advances are needed in detectors, solid-state materials manufacturing, calibration methods, data formatting, compression and transmission, SAR system design, and optics and cooling technologies. Consideration should also be given to planning for a GEO space station. M.S.K.

#### A85-15070#

##### THE INFLUENCE OF THE SPECTRAL RESPONSE OF SATELLITE SENSORS ON ESTIMATES OF BROADBAND ALBEDO

K. P. SHINE (Oxford University, Oxford; Liverpool, University, Liverpool, England), A. HENDERSON-SELLERS (Liverpool, University, Liverpool, England), and A. SLINGO (Meteorological Office, Bracknell, Berks., England) Royal Meteorological Society, Quarterly Journal (ISSN 0035-9009), vol. 110, Oct. 1984, p. 1170-1179. refs

(Contract NSF ATM-80-18898)

The causes for differences in the spectral responses of NOAA and Nimbus scanning radiometer data for the whole earth albedo are investigated in an attempt to provide a better data base for cloud-climate feedback calculations. A total of 45 mos of data from the NOAA 2-5 spacecraft were analyzed with a shortwave radiative transfer scheme for the changing surface albedo, atmospheric profile, cloud optical thickness, solar zenith angle, and cloud height at high and midlatitudes. Comparisons were made between the albedo from a complete solar spectrum and the limited band responses of the radiometers. The limited response of the radiometers led to overestimations of the total albedo changes. The estimates erred by factors of 0.075-0.43. It is concluded that cloud-climate feedback calculations cannot be carried out unless correction factors can be identified for the radiometer data set employed, which will depend on the responses of the particular radiometer. M.S.K.

#### A85-17476\*

##### 1983 INTERNATIONAL GEOSCIENCE AND REMOTE SENSING SYMPOSIUM (IGARSS '83), SAN FRANCISCO, CA, AUGUST 31-SEPTEMBER 2, 1983, DIGEST. VOLUMES 1 & 2

Symposium sponsored by IEEE, European Association of Exploration Geophysics, NASA, et al. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, Vol. 1, 541 p.; vol. 2, 451 p. For individual items see A85-17477 to A85-17605.

Various papers on remote sensing are presented. The general topics addressed include: remote sensing of the biosphere, geophysical inversion, science and archaeology, image processing, sensing the atmosphere with microwaves, analysis of scattering for remote sensing, advanced sensors and technology, archaeology, data processing, fiber optics, Landsat-4 and TM. Also discussed are: remote sensing and microwave instrumentation, soil moisture and hydrology, measurement techniques for ocean surface waves, geological remote sensing, radar millimeter wave propagation through the atmosphere, and remote sensing in planetary science, geophysics, hydrology, oceanography, and surface vegetation. C.D.

A85-17530\* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

##### MONITORING GLOBAL VEGETATION USING NOAA-7 AVHRR DATA

J. A. GATLIN, R. J. SULLIVAN, and C. J. TUCKER (NASA, Goddard Space Flight Center, Greenbelt, MD) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 5 p. refs

The NOAA-7 polar orbiting, sun-synchronous, operational satellite carries the 5 channel Advanced Very High Resolution Radiometer (AVHRR). Data are acquired globally at a resolution of 4 km on a daily basis. This data provides the means of frequently monitoring global vegetation on continental scales. Techniques for compositing and cloud screening a vegetation index for Africa are presented. The sample data set covers 9 days beginning August 16, 1983 and is compared with a semi-operational vegetation index product produced by NOAA. Author

## 08 INSTRUMENTATION AND SENSORS

**A85-17555\*** Technicolor Government Services, Inc., Moffett Field, Calif.

### **SPECTRAL, SPATIAL AND RADIOMETRIC FACTORS IN COVER TYPE DISCRIMINATION**

D. ALEXANDER, J. BUIS, W. ACEVEDO (Technicolor Government Services, Inc., Moffett Field, CA), and R. WRIGLEY (NASA, Ames Research Center, Moffett Field, CA) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 8 p. refs

The influence of spatial, spectral, and radiometric resolutions on the utilization of Thematic Mapper (TM) and Multispectral Scanner (MSS) data is assessed quantitatively using a  $2 \times 2 \times 2$  factorial design experiment. Eight possible factor combinations were examined for agricultural, urban, forestry, range, and water types of land covers for three levels of information. Spectral bandwidths were configured to simulate all four Landsat MSS channels and Landsat TM channels 1, 2, 3, 4, and 7. By means of bar charts and tables it is shown that the 8-bit radiometric and 75-meter spatial resolutions provide a higher overall accuracy than the 6-bit radiometric and 25-meter spatial resolutions. Spectrally, the difference between the four MSS channels and five TM channel configurations is noted to be insignificant. L.T.

**A85-17572**

### **MICROWAVE REMOTE SENSING IN THE PEOPLE'S REPUBLIC OF CHINA**

MENG and KAN (Jiaotong University, Shanghai, People's Republic of China) IN: 1983 International Geoscience and Remote Sensing Symposium (IGARSS '83), San Francisco, CA, August 31-September 2, 1983, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1983, 2 p.

The current status of research in the area of microwave remote sensing in China is briefly reviewed. The microwave remote sensing instruments developed by various Chinese research organizations include microwave radiometers, synthetic aperture radar, an X-band scatterometer, an X-band altimeter, and a real aperture imaging radar. These instruments have been tested in flight with good results. Some current applications of microwave remote sensing in China are discussed. V.L.

**A85-17756**

### **REMOTE SENSING IN NEW ZEALAND - A STATUS REPORT**

S. E. BELLIS (Department of Scientific and Industrial Research, Physics and Engineering Laboratory, Lower Hutt, New Zealand) International Journal of Remote Sensing (ISSN 0143-1161), vol. 5, Nov.-Dec. 1984, p. 877-881. refs

It is pointed out that New Zealand's experience with multispectral remote sensing began in 1973 when the Physics and Engineering Laboratory, DSIR, formed its Remote Sensing Section. This section became one of the principal investigators on NASA's Landsat-2 program. The first experience with remote sensing is related to aerial surveys flown over Christchurch in 1926, while systematic aerial photographic coverage of the entire country commenced by 1936. Attention is given to the physiography of New Zealand, satellite coverage, data users, image processing equipment, application projects, and aspects of equipment development. G.R.

**A85-17760**

### **ATMOSPHERIC SPECTRAL ATTENUATION OF AIRBORNE REMOTE-SENSING DATA - COMPARISON BETWEEN EXPERIMENTAL AND THEORETICAL APPROACH**

H. T. C. VAN STOKKOM (Rijkswaterstaat, Delft, Netherlands) and R. GUZZI (Ferrara, Università, Ferrara, Italy) International Journal of Remote Sensing (ISSN 0143-1161), vol. 5, Nov.-Dec. 1984, p. 925-938. refs

Data obtained in remote-sensing operations have to be corrected for atmospheric effects. Several models for such a correction have been developed. However, these models are only applicable in cases involving a consideration of the entire atmosphere. In The Netherlands much attention is given to remote

sensing operations carried out with the aid of airborne instruments. Therefore, a correction algorithm is needed which will provide a correction for only a part of the atmosphere, taking into account the altitude of the airborne platform. The present investigation, which includes a flight on August 26, 1980 with a digital multispectral scanner and two cameras, was conducted to study questions arising in connection with such an algorithm. It is concluded that proper correction of remotely sensed data can only be obtained if the atmospheric properties at the time of the experiment are known for the given location. G.R.

**N85-10094#** Physics Lab. RVO-TNO, The Hague (Netherlands). Researchgroep 1: Fysica.

### **SATELLITE RECONNAISSANCE**

G. P. DELOOR Jun. 1984 27 p refs Partly in DUTCH and ENGLISH

(Contract A83/K/075)

(AD-B085034; PHL-1984-41; TDCK-79367) Avail: NTIS HC A03/MF A01

The potential of the observation equipment in remote sensing satellites is described. United States meteorology, land use and oceanography satellites and the major US Earth observation programs are listed. Imaging satellite systems are described such as: visible light and near infrared, thermal IR window, and microwave window. It is concluded that a geometrical resolution between 10 and 40 m can be expected. In order to reduce the data flow from the satellite system the input side of the system (the object-sensor interaction) has to be known. Satellites with synthetic aperture radar are increasingly important, but satellites can never fully replace observations with aircraft and drones. Author (ESA)

**N85-10350#** Naval Research Lab., Washington, D. C.

### **FLIGHT DEMONSTRATION OF NEW NRL REAL-TIME DATA ACQUISITION SYSTEM AND LASER VIDEO WAVEFORM SAMPLER**

C. S. LIN, E. A. ULIANA, and D. L. HAMMOND 3 Sep. 1984 16 p

(AD-A145126; NRL-MR-5396) Avail: NTIS HC A02/MF A01 CSCL 09B

A new NRL Laser Video Waveform Sampler and Real-Time Data Acquisition System were installed in a RP-3A aircraft and data were obtained in a test flight over the Great Dismal Swamp area on 28 June 1982. The data are in time amplitude pairs, which give both range and reflectivity, and are stored on magnetic tape. The returns show reflections from various levels of the canopy. The results show that it is possible to profile a complicated terrain in order to determine the vegetation and undergrowth height and the relative reflectivities of the various surface. Author (GRA)

**N85-11406\*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

### **IMAGING SCIENCE PANEL. MULTISPECTRAL IMAGING SCIENCE WORKING GROUP JOINT MEETING WITH INFORMATION SCIENCE PANEL: INTRODUCTION Final Report**

In its The Multispectral Imaging Sci. Working Group, Vol. 2 p 33-60 7 Sep. 1982 refs ERTS

Avail: NTIS HC A15/MF A01 CSCL 05B

The state-of-the-art of multispectral sensing is reviewed and recommendations for future research and development are proposed. Specifically, two generic sensor concepts were discussed. One is the multispectral pushbroom sensor utilizing linear array technology which operates in six spectral bands including two in the SWIR region and incorporates capabilities for stereo and crosstrack pointing. The second concept is the imaging spectrometer (IS) which incorporates a dispersive element and area arrays to provide both spectral and spatial information simultaneously. Other key technology areas included very large scale integration and the computer aided design of these devices. M.G.

**N85-11439\*# Arizona Univ., Tucson. Optical Sciences Center. SPECTRORADIOMETRIC CALIBRATION OF THE THEMATIC MAPPER AND MULTISPECTRAL SCANNER SYSTEM Quarterly Report, 1 May - 1 Aug. 1984**

P. N. SLATER and J. M. PALMER, Principal Investigators 1 Aug. 1984 42 p refs ERTS (Contract NAS5-27382) (E85-10026; NASA-CR-174049; NAS 1.26:174049; QR-7) Avail: NTIS HC A03/MF A01 CSCL 08B

The reduction of the data measured on July 8, 1984 at White Sands, New Mexico is summarized. The radiance incident at the entrance pupil of the LANDSAT 5 sensors have been computed for bands 1 to 4. When these are compared to the digital counts of the TM image, the ground based calibration for this sensor will be given. The image was received from Goddard SFC and is presently being analyzed. Author

**N85-12199# Joint Publications Research Service, Arlington, Va. SATELLITE, AIRBORNE REMOTE SENSING DEVELOPMENT OUTLINED**

B. NEY *In its East Europe Rept.:* Sci. Affairs, No. 791 (JPRS-84624) p 118-127 26 Oct. 1983 Transl. into ENGLISH from Nauka Polska (Warsaw), no. 1-2, Jan. - Feb. 1983 p 87-95 Avail: NTIS HC A07/MF A01

The development of airborne remote sensing techniques and hardware design is examined. Emphasis is placed on data acquisition and processing as well as satellite remote sensing and earth resource exploration. M.A.C.

**N85-12281# Defence Research Establishment, Ottawa. (Ontario).**

**PRODUCTION OF OPTICALLY CORRELATED SEASAT-A (SEA SATELLITE) SAR (SYNTHETIC APERTURE RADAR) IMAGERY AT DREO (DEFENCE RESEARCH ESTABLISHMENT OTTAWA)** N. BROUSSEAU and J. W. A. SALT Mar. 1984 25 p (AD-A145970; DREO-TN-82-19) Avail: NTIS HC A02/MF A01 CSCL 17I

Examples of optically-correlated imagery from the SEASAT-A Synthetic Aperture Radar are presented. A list of the imagery produced at DREO is included. Author (GRA)

**N85-13356\*# SAR, Inc., Riverdale, Md. LANDSAT INSTRUMENTS CHARACTERIZATION**

Y. LEE, Principal Investigator Aug. 1984 19 p ERTS (Contract NAS5-28200) (E85-10032; NASA-CR-174123; NAS 1.26:174123) Avail: NTIS HC A02/MF A01 CSCL 05B

Several studies were performed using LANDSAT-4 and -5 simultaneous overpath data 40608-15472 and 50014-15465 over Pensacola, FL. The overlap region of these two scenes was determined visually on the IAT and then sampled into 32 x 32 segments. The mean and standard deviation (SD) for each segment were calculated. In general, the plots of the means of LANDSAT-4 versus LANDSAT-5 lie on the diagonal line. Some of the data lie out of the diagonal line, which indicates a possible bidirectional observation effect occurs. In addition to editing the five FCL files on CALDUMP tapes into seven 1000 minor frame (MF). CAL files, program LEE.FOR was modified to use information from start of shutter obscuration extracted from program START.FOR to create seven 200 MF.CAL files that can be run through the current TRAPP program for TM sensor characterization. The location of start of shutter obscuration was determined for both LANDSAT-4 and -5. A.R.H.

**N85-14197\*# SAR, Inc., Riverdale, Md. LANDSAT INSTRUMENTS CHARACTERIZATION**

Y. LEE, Principal Investigator Sep. 1984 6 p ERTS (Contract NAS5-28200) (E85-10028; NASA-CR-174119; NAS 1.26:174119) Avail: NTIS HC A02/MF A01 CSCL 05B

Twelve subscenes were selected from LANDSAT 5, scene 50129-17075 over White Sands, NM. Data set WHITE covers the entire White Sands desert area. Black and white films and hard

copy prints of each band in this area were produced. A new command file was written for the interactive digital image manipulation system (IDIMS) to generate pseudocolor pixel prints of LANDSAT Thematic Mapper bands for data from B and A tapes. The program PCMAIN.FOR of principal component analysis and a supplemental program HEDIT.FOR for generating sampled data sets were developed. The procedures for performing component analysis on a subscene by using these programs are described. Modifications to various subroutines are listed. Bright target saturation internal calibration lamp state dependence was examined using calibration data of night scene 50052-02182, WRS 111/112 over Harrisburg, PA. R.S.F.

**N85-14198\*# SAR, Inc., Riverdale, Md. LANDSAT INSTRUMENTS CHARACTERIZATION**

Y. LEE, Principal Investigator Jul. 1984 16 p ERTS (Contract NAS5-28200) (E85-10029; NASA-CR-174120; NAS 1.26:174120) Avail: NTIS HC A02/MF A01 CSCL 08B

The present CALDUMP tape consists of five calibration files and one reduced calibration file. The calibration files, each with data of 200 pixels, cover an entire calibration region starting from the 6251 minor frame (mf). Program LEE.FOR was developed to edit these five files into seven .CAL files in the TAE mode. Program PCAL.FOR reads the .CAL files and plots the 1000 pixels of any scan line in linear or log scale. The typical spectra of the calibration region of forward and reverse scans are shown. The positions of the start and the end of shutter obscuration and the calibration pulse are shifted increasingly or decreasingly from Channel 1 to Channel 16, due to the timing of data acquisition. To produce TRAPP usable input files are, the following procedures need to be taken: (1) determine the start of shutter obscuration position; (2) determine the calibration pulse and background region relative to the start of shutter obscuration; and (3) determine the end of shutter obscuration position. M.G.

**N85-14199\*# SAR, Inc., Riverdale, Md. LANDSAT INSTRUMENTS CHARACTERIZATION**

Y. LEE, Principal Investigator Jun. 1984 3 p ERTS (Contract NAS5-28200) (E85-10030; NASA-CR-174121; NAS 1.26:174121) Avail: NTIS HC A02/MF A01 CSCL 08B

Work performed for the LANDSAT instrument characterization task in the areas of absolute radiometry, coherent noise analysis, and between-date smoothing is reported. Absolute radiometric calibration for LANDSAT-5 TM under ambient conditions was performed. The TM Radiometric Algorithms and Performance Program (TRAPP) was modified to create optional midscan data files and to match the TM Image Processing System (TIPS) algorithm for pulse determination. Several data reduction programs were developed, including a linear regression and its plotted result. A fast Fourier transformation study was conducted on the resequenced TM data. Subscenes of homogeneous water within scenes over Pensacola, Florida were used for testing the FFT on the resequenced data. Finally, a gain and pulse height stability study of LANDSAT 5 TM spectral bands was performed. M.G.

**N85-14200\*# SAR, Inc., Riverdale, Md. CHARACTERIZING THE SCIENTIFIC POTENTIAL OF SATELLITE SENSORS**

Y. LEE, Principal Investigator Oct. 1984 13 p Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS (Contract NAS5-28200) (E85-10031; NASA-CR-174122; NAS 1.26:174122) Avail: NTIS HC A02/MF A01 CSCL 05B

Algorithms and software were developed for the correction of coherent noise, scan correlated shift, and the bright target saturation effect in Thematic Mapper imagery. In addition, a package of LANDSAT Assessment System programs was developed to demonstrate the results from TM radiometric characterization and calibration work. M.G.



## 08 INSTRUMENTATION AND SENSORS

**N85-14202#** European Space Agency, Paris (France).  
**EARSSEL/ESA SYMPOSIUM ON INTEGRATIVE APPROACHES IN REMOTE SENSING**

N. LONGDON, comp. and O. MELITA, comp. Aug. 1984 382 p refs Symp. held at Guildford, England, 8-11 Apr. 1984; sponsored by UK Dept. of Trade and Industry, UK Natural Environment Research Council and UK National Remote Sensing Centre (ESA-SP-214; ISSN-0379-6566) Avail: NTIS HC A17/MF A01

Methodologies for integrative approaches to remote sensing; applications of integrative remote sensing; land applications; ocean and atmospheric applications; the Spacelab metric camera; and economic aspects of remote sensing were discussed.

**N85-14222#** Technische Univ., Munich (West Germany). Inst. fuer Geographie.

**MODULAR OPTOELEKTRONISCHER MULTISPEKTRALER SCANNER (MOMS), INTERPRETATION AND EVALUATION OF THE MOMS IMAGE ARICA, WEST COAST OF SOUTH AMERICA**

H. G. GIERLOFF-EMDEN In ESA EARSEL/ESA Symp. on Integrative Approaches in Remote Sensing p 169-177 Aug. 1984 refs

Avail: NTIS HC A17/MF A01

Analysis of Modular Optoelectronic Multispectral Scanner (MOMS) imagery to extract cartographic, land use, oceanographic, and geological information is outlined. The MOMS imaging experiment from orbit was successful. The MOMS System can deliver images with additional information for thematic maps (from 300 km orbit height) up to map scales 1:200,000. An evaluation for topographic maps under these conditions seems to be possible for map scales 1:300,000. The geometric conditions are very good. An additional spectral band is recommended.

Author (ESA)

**N85-14229#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany).

**METRIC CAMERA EXPERIMENT: SPACELAB 1 MISSION**

M. SCHROEDER In ESA EARSEL/ESA Symp. on Integrative Approaches in Remote Sensing p 235-241 Aug. 1984  
Avail: NTIS HC A17/MF A01

A calibrated mapping camera to photograph the Earth was flown on the Spacelab 1 mission. It is a Zeiss RMK 305 mm aerial survey camera, modified to expose image number, time of release event, exposure time, f-stop, and a six-step gray wedge on every image frame. Image scale is 1:820,000, giving 190 x 190 km ground coverage for the 23 x 23 cm image format. For stereoscopic evaluation images were taken with at least 60% overlap in flight direction. An area of 11 million sq km was photographed, of which 70% is suitable for evaluation. Color infrared film was used for 550 photographs, black and white film for 450 photographs. Objects on the ground of 20 m can be recognized, in spite of the poor lighting conditions. Author (ESA)

**N85-14230#** Technische Univ., Hanover (West Germany).  
**THE PHOTOGRAMMETRIC CAMERA EXPERIMENT ON SPACELAB 1**

G. KONECNY In ESA EARSEL/ESA Symp. on Integrative Approaches in Remote Sensing p 243-250 Aug. 1984 refs  
Avail: NTIS HC A17/MF A01

A Zeiss RMK 30/23 photogrammetric camera was carried on Spacelab 1. The mission returned 1020 high resolution photographs in infrared false color or black and white over Asia, Africa, Europe and the Americas. The images are suitable for topographic and thematic mapping at the scale 1:100,000. A reflight with higher resolution is planned on the NASA EOM-1 mission in June 1985.

Author (ESA)

**N85-14248#** Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Raumfahrt.

**ELECTRONIC SATELLITE IMAGING SYSTEM MOMS-ESA Final Report, May 1983.**

D. MEISSNER and M. HOFMANN Bonn Bundesministerium fuer Forschung und Technologie Aug. 1984 58 p refs Partly in GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie (BMFT-FB-W-84-033; ISSN-0170-1339) Avail: NTIS HC A04/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 12

An airborne/spaceborne remote imaging instrument was developed. The mapping principle is based on electrical scanning with high resolution linear photo-arrays (pushbroom principle, CCD technology). By combining several similar modules the scanning is done in several pixel-coincide spectral channels between 0.45 and 1.05 micron wavelength. Any line length can be obtained using the double lens principle (at present 6912 pixels). The signals are corrected in real time for the different dark signals, for the different sensitivities of the single elements and for each lens transmittance. The digitized and corrected data are then stored on a high density tape.

Author (ESA)

**N85-14419#** Sandia Labs., Albuquerque, N. Mex.

**A NEW PHYSICAL LAGRANGIAN TRACER**

B. D. ZAK 1984 5 p refs Presented at the Atmospheric Tracer Workshop, Santa Fe, N. Mex., 21-25 May 1984 Submitted for publication  
(Contract DE-AC04-76DP-00789)

(DE84-016212; SAND-84-1701C) Avail: NTIS HC A02/MF A01

A physical Lagrangian tracer will be operational and available for use within the near future. The tracer is an adjustable buoyancy constant volume balloon with an onboard microprocessor to serve an appropriate array of sensors, and to control buoyancy. Tracking and data reporting is to be accomplished via the ARGOS satellite-borne data system yielding both a local and a world-wide capability.

DOE

**N85-15245** Department of the Air Force, Washington, D.C.

**PHOTO-RECONNAISSANCE SYSTEM Patent**

J. E. VERDIER, inventor (to Air Force) 10 Apr. 1984 6 p  
Supersedes AD-D009887

(AD-D011287; US-PATENT-4,442,453;

US-PATENT-APPL-SN-347383; US-PATENT-CLASS-358-109)

Avail: US Patent and Trademark Office CSCL 14E

A photo-reconnaissance system is disclosed in which the landscape is photographed on film. The film is then developed and scanned by electro-optical sensors. The output signal from the E-O sensors is transmitted to a ground station where it is demultiplexed and displayed on a plurality of television type monitors. An operator can view the reconnaissance scene in near-real time and transmit commands back to the airborne station directing a change in flight course or a magnification of a particular target. A permanent record of the reconnaissance scene can be obtained either from the on-board film or by making a print from the television type monitors.

GRA

**N85-15254#** Naval Research Lab., Washington, D. C.

**A BRIEF INVESTIGATION INTO THE VALIDITY OF SEASAT RADAR ALTIMETER DATA ACQUIRED OVER LAND**

D. M. HORAN and L. W. CHOY 26 Sep. 1984 27 p

(Contract W05-270-S; R14-52-SB)

(AD-A146560; AD-E000602; NRL-MR-5419) Avail: NTIS HC A03/MF A01 CSCL 17I

The SEASAT 1 satellite, which was launched in 1978, carried a radar altimeter which was optimized for operation over the open ocean. However, the instrument did make a significant number of measurements while over land. It is conclusively demonstrated that the radar altimeter serendipitously made measurements over relatively flat terrain which can provide accurate ground elevations. In addition, it is possible that the instrument had some capability to distinguish ground features such as canals, elevated roads, and power lines.

GRA



## 09

## GENERAL

Includes economic analysis.

**A85-10179\*#** National Aeronautics and Space Administration, Washington, D. C.

**EARTH REMOTE SENSING - 1970-1995**

P. G. THOME (NASA, Washington, DC) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 35-39.

The past-achievements, current status, and future prospects of the Landsat terrestrial-remote-sensing satellite program are surveyed. Topics examined include the early history of space flight; the development of analysis techniques to interpret the multispectral images obtained by Landsats 1, 2, and 3; the characteristics of the advanced Landsat-4 Thematic Mapper; microwave scanning by Seasat and the Shuttle Imaging Radar; the usefulness of low-resolution AVHRR data from the NOAA satellites; improvements in Landsats 4 and 5 to permit tailoring of information to user needs; expansion and internationalization of the remote-sensing market in the late 1980s; and technological advances in both instrumentation and data-processing predicted by the 1990s. T.K.

**A85-10264\*#** Lockheed Engineering and Management Services Co., Inc., Houston, Tex.

**OSTA-3 SHUTTLE PAYLOAD**

R. D. DILLMAN, B. B. EAV (Lockheed Engineering and Management Services Co., Inc., Houston, TX), and R. R. BALDWIN (NASA, Johnson Space Center, Houston, TX) IN: International Symposium on Remote Sensing of Environment, 17th, Ann Arbor, MI, May 9-13, 1983, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1984, p. 1165-1177. refs

The Office of Space and Terrestrial Applications-3 payload, scheduled for flight on STS Mission 17, consists of four earth-observation experiments. The Feature Identification and Location Experiment-1 will spectrally sense and numerically classify the earth's surface into water, vegetation, bare earth, and ice/snow/cloud-cover, by means of spectra ratio techniques. The Measurement of Atmospheric Pollution from Satellite experiment will measure CO distribution in the middle and upper troposphere. The Imaging Camera-B uses side-looking SAR to create two-dimensional images of the earth's surface. The Large Format Camera/Attitude Reference System will collect metric quality color, color-IR, and black-and-white photographs for topographic mapping. O.C.

**A85-12501**

**INTERNATIONAL SCIENTIFIC CONFERENCE ON SPACE, 23RD, ROME, ITALY, MARCH 24, 25, 1983, PROCEEDINGS [CONVEGNO INTERNAZIONALE SCIENTIFICO SULLO SPAZIO, 23RD, ROME, ITALY, MARCH 24, 25, 1983, ATTI]**

Conference sponsored by the Ministero degli Affari Esteri, Ministero per il Coordinamento della Ricerca Scientifica e Tecnologica, CNR, et al. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1984, 400 p. In Italian, English, and French. For individual items see A85-12502 to A85-12524.

Political, economic, institutional, and technological aspects of space cooperation between industrialized and developing nations are examined in reviews, reports, and abstracts. Topics addressed include satellite communications, the Spacelab program as an easy opportunity for developing-country (DC) participation, Italian cooperation with DCs in space development, economical domestic/regional satellite communication systems for DC, the activities of the Argentine National Commission on space research, the role of the UN, applications of space technology in Africa, the orbit-acquisition maneuver for the Lageos-II satellite, strap-on

boosters for the Ariane-3 launcher, and the interpretation of thermal-IR imagery using multispectral and multitemporal information. Graphs, drawings, diagrams, and photographs are provided. T.K.

**A85-12505#**

**THE NEED FOR CO-OPERATION BETWEEN DEVELOPING AND INDUSTRIALISED COUNTRIES FROM AN AFRICAN STANDPOINT**

B. A. SIKILO (Regional Centre for Services in Surveying, Mapping and Remote Sensing, Nairobi, Kenya) IN: International Scientific Conference on Space, 23rd, Rome, Italy, March 24, 25, 1983, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1984, p. 99-114.

The remote-sensing needs of developing countries are discussed from an African standpoint. The impact the technology would have in the development of Africa's natural-resources potential is explained. The paper also examines the technology-transfer problems and points out ways for it to be more effective. The cooperation must not be only between industrial and developing countries (vertical) but also among developing countries themselves (horizontal). Author

**A85-12509#**

**PROSPECTS OF SPACE TECHNOLOGY AND APPLICATIONS IN AFRICA**

T. J. BAXTER and H. OUEDRAOGO (United Nations, Economic Commission for Africa, Addis Ababa, Ethiopia) IN: International Scientific Conference on Space, 23rd, Rome, Italy, March 24, 25, 1983, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1984, p. 165-176.

The present and potential use of space technology by African states is discussed. The slowly beginning but significant utilization of satellite services for communications, remote sensing of natural resources, and meteorological data by Africa is reviewed, and organizational efforts to define needs and improve regional cooperation are surveyed. Specific problems in enhancing this utilization are examined, including lack of African input into the design of telecommunications and remote-sensing satellites, insufficient numbers of trained personnel, limited data access, incompatibility of systems, the high costs of some services, limits imposed by developed countries on technology transfer, and the lack of a legal framework. Cooperative development of space-technology capabilities in African states, as means to economic and social ends and complementing other technologies, is recommended. T.K.

**A85-12510#**

**GLOBAL CO-OPERATION IN THE FIELD OF EARTH RESOURCES SATELLITES**

L. MARELLI (ESA, Earthnet Programme Office, Frascati, Italy) IN: International Scientific Conference on Space, 23rd, Rome, Italy, March 24, 25, 1983, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1984, p. 185-195.

The development of organizational structures to facilitate international cooperation in the satellite remote sensing of earth resources is reviewed, with an emphasis on the role of ESA. The history of remote sensing of the land (Landsat and the worldwide network of Landsat ground stations), the new generation of land observers (Landsat-4, SPOT, and MOS-1), and the ocean and ice monitoring satellites (Seasat, Nimbus-7, and ERS-1) are characterized and illustrated with maps, drawings, and sample images. Organized efforts to coordinate these activities and provide access to developing countries include the programs of NASA and the French SPOT system, conferences and symposia, the UN, global aid institutions, the multilateral conferences initiated by Canada in 1980, and the 1982 Unispace conference; ESA contributions center on the ERS-1, Meteosat, and Earthnet projects. T.K.

**A85-12515#****JAPANESE SATELLITE DEVELOPMENT RELATED TO INTERNATIONAL COOPERATION**

M. HIRAI (National Space Development Agency of Japan, Tokyo, Japan) IN: International Scientific Conference on Space, 23rd, Rome, Italy, March 24, 25, 1983, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1984, p. 231-238.

The technical features of present and planned Japanese terrestrial-remote-sensing satellites are reviewed. GMS-2 and its predecessor GMS are meteorological observation satellites in GEO at 140 deg E providing whole-earth cloud-cover images in the visible and IR by means of a spin-scan radiometer; MOS-1 is a marine-observation satellite with a multispectral electronic self-scanning radiometer, a visible/thermal-IR radiometer, and a microwave scanning radiometer and is scheduled for launch in 1986 to a sun-synchronous orbit of altitude 909 km and inclination 99.1 deg; ERS-1 is a land-resources satellite proposed for launch in 1987-1988 to a sun-synchronous orbit of altitude 570 km and inclination about 98 deg. T.K.

**A85-13047#****SPOT 3 - A FOLLOW-ON PROGRAM**

L. DULHERM and A. MIZZI (Centre National d'Etudes Spatiales, Toulouse, France) International Astronautical Federation, International Astronautical Congress, 35th, Lausanne, Switzerland, Oct. 7-13, 1984. 4 p. (IAF PAPER 84-94)

Upgraded remote sensing capabilities using a SPOT 3 configuration in the 1990s are described. SPOT 1 and 2 satellites are currently in their engineering phase, with SPOT 1 being scheduled for 1985 launch. SPOT 3 will have heightened sensitivity in the 10 m resolution B2 band for urban planning and coastal scanning. The medium IR band will be optimized for agricultural monitoring and discriminating various lithological formations. The blue band may be eliminated on SPOT 3 due to the continued presence of the SPOT 1 and 2 spacecraft covering those wavelengths. SPOT 3 data rates would be increased to 50-100 Mb/sec, and the lifetime would be lengthened by extending the capacity of the Ni-Cd batteries. Finally, passenger facilities may be provided, thus requiring larger power supplies and redesigns of many support systems. The increased capabilities would cause an alteration in the basis for the SPOT acronym to Services and Productivity by Observation of Terra. M.S.K.

**A85-13048#****AN OVERVIEW ON JAPANESE REMOTE SENSING PROGRAM**

Y. HORIKAWA (National Space Development Agency of Japan, Tokyo, Japan) International Astronautical Federation, International Astronautical Congress, 35th, Lausanne, Switzerland, Oct. 7-13, 1984. 4 p. (IAF PAPER 84-95)

Present and future Japanese remote sensing programs being directed from an Earth Observation Center in Japan are outlined. The third generation geostationary meteorological satellite (GMS-3) is being developed while efforts are expended to characterize causes of errors in the GMS-2 redundant scan drive. A mismatching of circuits or EM interference are two prime problem candidates thus far. The GMS-3 is being readied for a 1986 launch and will carry a multiband, visible and IR, and microwave radiometers. The MOS-1 algorithms are still in development. An earth remote sensing satellite, ERS-1, is planned for 1990 launch and is presently undergoing definition studies. ERS-1 will carry SAR, visible and near-IR sensors, will weigh 1400 kg at launch, and will be placed in orbit by an H-1 launch vehicle. M.S.K.

**A85-13078#****A REVIEW OF DEVELOPMENTS IN SPACE REMOTE SENSING FOR MONITORING RESOURCES**

A. H. WATKINS, D. T. LAUER, G. B. BAILEY, D. G. MOORE, and W. G. ROHDE (U.S. Geological Survey, Reston, VA) International Astronautical Federation, International Astronautical Congress, 35th, Lausanne, Switzerland, Oct. 7-13, 1984. 31 p. refs (IAF PAPER 84-132)

Space remote sensing systems are compared for suitability in assessing and monitoring the earth's renewable resources. The paper includes specific examples of vegetative land-cover and soils mapping, urban area analysis, biomass and fire-fuel buildup monitoring, and a discussion of the compatibility of space remotely sensed data with other forms of image and non-image spatial data. Author

**A85-16890****GEODYNAMIC APPLICATIONS OF ALTIMETER DATA [GEODYNAMISCHE ANWENDUNGEN VON ALTIMETERDATEN]**

E. GROTEN and B. STOCK (Darmstadt, Technische Hochschule, Darmstadt, West Germany) Zeitschrift fuer Flugwissenschaften und Weltraumforschung (ISSN 0342-068X), vol. 8, Sept.-Oct. 1984, p. 340-345. In German. Research supported by the Deutsche Forschungsgemeinschaft. refs

Geodetic-geophysical applications in the area of geodynamics are examined in terms of goals, present accuracies, state of the art, and future potential, including accuracy requirements. The analysis of Seasat satellite altimetry data and their application to the eastern Mediterranean are reported. Global geodetic and local geophysical aspects are considered. A strong correlation is found between satellite altimetry and oceanic bathymetry for the eastern Mediterranean. The possibility of using altimeter data to detect topographic and density variations beneath the ocean surface and to determine the temporal and spatial variations of the sea surface relative to an equipotential surface is addressed. The determination of oceanic tides as a further application is discussed. C.D.

**N85-11025\*# Metrics, Inc., Atlanta, Ga.****THE FUTURE OF SATELLITE REMOTE SENSING: A WORLDWIDE ASSESSMENT AND PREDICTION Abstract Only**

G. W. SPANN In NASA. Marshall Space Flight Center 2nd Symp. on Space Industrialization p 96 Oct. 1984  
 Avail: NTIS HC A19/MF A01 CSDL 05B

A frame-work in which to assess and predict the future prospects for satellite remote sensing markets is provided. The scope of the analysis is the satellite-related market for data, equipment, and services. It encompasses both domestic and international markets and contains an examination of the various market characteristics by market segment (e.g., Federal Government, State and Local Governments, Academic Organizations, Industrial Companies, and Individuals) and primary applications areas (e.g., Geology, Forestry, Land Resource Management, Agriculture and Cartography). The forecasts are derived from an analysis of both U.S. and foreign market data. The evolution and current status of U.S. and Foreign markets to arrive at market growth rates is evaluated. Circumstances and events which are likely to affect the future market development are examined. A market growth scenario is presented that is consistent with past data sales trends and takes into account the dynamic nature of the future satellite remote sensing market. Several areas of current and future business opportunities available in this market are discussed. Specific worldwide forecasts are presented in three market sectors for the period 1980 to 1990. M.G.

**N85-11107#** Joint Publications Research Service, Arlington, Va.  
**SPACE RESEARCH BENEFITS NATIONAL ECONOMY**

I. YEGOROVA and Y. ZAYTSEV *In its USSR Rept.: Space*  
 (JPRS-USP-84-005) p 84-94 26 Oct. 1984 Transl. into ENGLISH  
 from *Politicheskoye Samobrazovaniye* (Moscow), no. 1, Jan. 1984  
 p 58-66

Avail: NTIS HC A07

The role of the space program in the economic development of the Soviet Union is examined. Emphasis is placed on the history and applications of satellite information as well as the continued development of space technology. Objectives of satellite remote sensing include natural resource management, meteorology, geophysics, the improvement of space communications, and increased accuracy of crop inventory and soil moisture detection techniques. M.A.C.

**N85-11426\*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

**A REPORT ON THE TRAINING COURSE AT FORTALEZA (CEARA) [RELATORIO DO CURSO DE TREINAMENTO DE FORTALEZA (CEARA)]**

M. P. BARBOSA, Principal Investigator Dec. 1983 28 p In  
 PORTUGUESE; ENGLISH summary Sponsored by NASA  
 ERTS

(E85-10013; NASA-CR-168570; NAS 1.26:168570;  
 INPE-2989-RPE/453) Avail: NTIS HC A03/MF A01 CSCL  
 05B

The activities of the on the job training course Applications of the Remote Sensing Data, with Emphasis on LANDSAT Images, to Study the Natural Resources are described. M.A.C.

**N85-14209#** Food and Agriculture Organization of the United Nations, Rome (Italy).

**INTERNATIONAL COOPERATION IN REMOTE SENSING APPLICATIONS**

J. A. HOWARD *In ESA EARSeL/ESA Symp. on Integrative Approaches in Remote Sensing* p 57-61 Aug. 1984 refs

Avail: NTIS HC A17/MF A01

The organization of satellite remote sensing within the UN system, and functions of the Food and Agriculture Organization Remote Sensing Center, which cover satellite and airborne methods and techniques are described. Bilateral and multilateral international cooperation are reviewed. Education and training, institution building, and equipment and follow-up activities to country based projects are outlined. The need to strengthen mechanisms of international cooperation, to expand training activities, to initiate pilot action studies in developing countries and to modify equipment to the conditions existing in many developing countries is stressed. Author (ESA)

**N85-14235#** Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

**ERS-1 AND ITS POTENTIAL FOR INDUSTRIAL UTILIZATION**

U. ERICH and D. H. GOTTSCHALK *In ESA EARSeL/ESA Symp. on Integrative Approaches in Remote Sensing* p 275-280 Aug. 1984 refs

Avail: NTIS HC A17/MF A01

The ERS-1 ESA satellite, its microwave instrumentation, ground segment, and data products are described. User groups are characterized and results of benefit calculations for ERS-1 are presented with reference to relevant SEASAT results. The prime center, as an interface between the satellite system and the end user, was investigated and found to be a suitable instrument to support case study activities during the preoperational phase and operational service. Industries involved in offshore activities are expected to be major users of ERS-1 data products.

Author (ESA)

**N85-15250\*#** Utah Univ., Salt Lake City. Center for Remote Sensing and Cartography.

**EFFECTIVE USE OF REMOTE SENSING PRODUCTS IN LITIGATION**

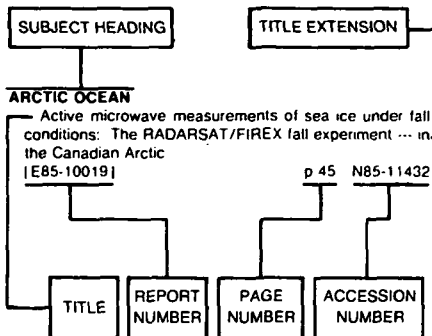
R. A. JAYNES 1983 10 p refs ERTS

(Contract NAGW-95)

(E85-10048; NASA-CR-174224; NAS 1.26:174224) Avail: NTIS  
 HC A02/MF A01 CSCL 05D

A boiled-down version of major legal principles affecting the admissibility of data and products from remote sensing devices is presented. It is suggested that enhancements or classifications of digital data (from scanning devices or from digitized aerial photography) be proffered as evidence in a fashion similar to the manner in which maps from photogrammetric techniques are introduced as evidence. Every effort should be made to elucidate the processes by which digital data are analytically treated or manipulated. Remote sensing expert witnesses should be practiced in providing concise and clear explanations of both data and methods. Special emphasis should be placed on being prepared to provide a detailed accounting of steps taken to calibrate and verify spectral characteristics with ground truth. Author

## Typical Subject Index Listing



The subject heading is a key to the subject content of the document. The title is used to provide a description of the subject matter. When the title is insufficiently descriptive of the document content, the title extension is added, separated from the title by three hyphens. The (NASA or AIAA) accession number and the page number are included in each entry to assist the user in locating the abstract in the abstract section (of this supplement). If applicable, a report number is also included as an aid in identifying the document. Under any one subject heading, the accession numbers are arranged in sequence with the AIAA accession numbers appearing first.

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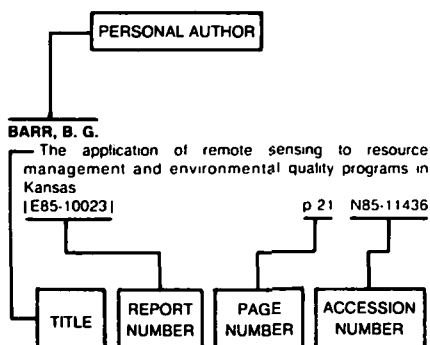
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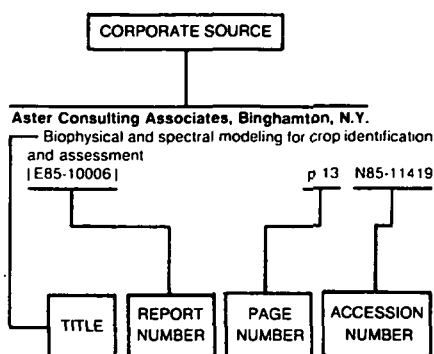
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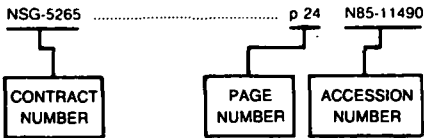
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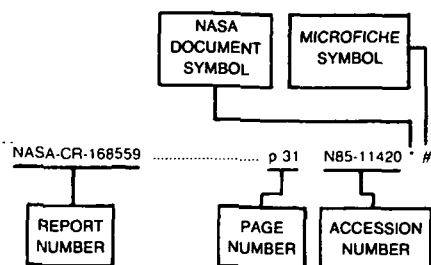
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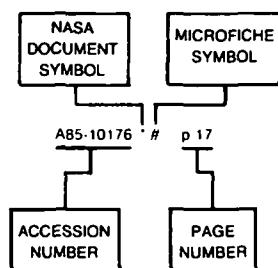


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